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A PRE-FEASIBILITY STUDY
OF THE
ECONOMICS OF CONSTRUCTING A FIXED-LINK
BETWEEN
THE LOWER MAINLAND AND VANCOUVER ISLAND
BRITISH COLUMBIA

For

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Canada

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CHAPTER ONE

A SYNOPSIS OF THE STUDY

INCLUDING

AN APPENDIX

ON

THE TECHNIQUES AND TERMINOLOGY OF PROJECT APPRAISAL

CHAPTER 1

An Economic Pre-Feasibility Study of a Fixed-Link between the Lower Mainland and Vancouver Island

A SYNOPSIS

1. Introduction:

1.1 The substance and details of this pre-feasibility study are contained in their entirety in the succeeding Chapters 2 through 7 of this Report. The purpose of this Chapter 1 is to provide the general reader with a synopsis of the Study and Report, while at the same time presenting a general introduction which will facilitate a clearer understanding of the analytical composition of the chapters that follow.

1.2 An early explanation of some of the analytical language used in this study e.g. discount rates, net present worths, is given in the appendix to this chapter.

2. Concept of a Fixed-Link

2.1 An exploration has begun to find some means of providing a permanent in-place "bridging" between the Mainland of B.C. and Vancouver Island in order to improve the transport links. This is no more "different-in-principle" than "bridging" the Lower Mainland and the Okanagan by way of the Hope-Princeton Highway. Both are "bridging" concepts differing only in that one is through the mountains and one is across water.

2.2 An improved and more economical means of transport is sought. A Fixed-Link could consist of one of a number of possible alternatives:- a bored tunnel beneath the sea-bed; a tunnel lying on the sea-bed; a floating tunnel immersed beneath sea-level; a floating bridge on pontoons; suspension bridges, etc. etc.

As technology advances other possible schemes will no doubt become feasible. It has been necessary to obtain advice from engineering firms as to what concept of Fixed-Link would now be technically feasible, operationally practicable and at what cost? Reports on this will be presented separately; they are not part of this pre-feasibility study of the economics of the concept. This study has however been prepared in the belief that the concept of a Fixed-Link is technically practicable; and on an assumption that its construction cost would be $3,000 million at 1980 prices.

2.3 The actual siting and location of a Fixed-Link would depend on what is technically possible, what the costs would be for different routes, where the traffic is, and an acceptance of environmental constraints. These are not covered in this report except insofar as it has been assumed that the Fixed-Link would have its point of take-off on the Mainland somewhere between Iona and Roberts Bank and on Vancouver Island in the general area of Ladysmith/ Duncan.

2.4 While the selection of the route is not part of this study, insofar as any route chosen would have to pass through the Gulf Islands, it is recognized that such routing should not be permitted to violate unduly the serenity of the Gulf Islands, and that therefore all crossings of the islands would be designed so as to prevent access by vehicles and passengers between the highway and the islands.

3. Objectives of the Study

3.1 These were stated above in the broadest terms. More specifically, the purpose of this study has been to determine whether, by constructing a Fixed-Link, traffic would be able to move more freely, at a lower cost than by ferry; whether other advantages would accrue from having a Fixed-Link; and whether the sum of all such benefits would justify the cost of constructing a Fixed-Link

to an extent greater than the benefits that justify the continuing need for further capital expenditures in the ferry services. It has been a search for the cheapest solution to providing transport facilities between the Mainland and the Island, to the best advantage of the Province in the coming decades.

In this particular context it would be unwise to take decisions on ferry service investments - ships and terminals that have a life of 30 years if there is the possibility that a lot of that would become obsolete if a Fixed-Link can be practically engineered and economically justified. Science and Technology have made such rapid advances particularly in the last thirty years that it can be assumed that equally rapid progress is likely in the future. It would therefore be short-sighted to plan ahead just on the basis of what we now have, unless it can be adequately shown that the current technology is still the best.

3.2 Attention is drawn to the description of this study as "a pre-feasibility study." This indicates that the objective has been to devise a methodology to be used in making an assessment of how worthwhile it would be to build a Fixed-Link; to determine what the variable factors are; to indicate an approximation of their absolute and relative values; and finally to relate the possible benefits to the possible costs. Detailed studies are very expensive and can take a long time. The purpose of a pre-feasibility study is to determine at a relatively small cost whether a full feasibility study is warranted, either now or at a later date.

4. Methods of Analysis

4.1 Ferry Services

The method of analysing the worth of constructing a Fixed-Link has been to evaluate its net benefits and investment costs against

the net revenues arising from continuing investment costs in ferry services. Only that part of the B.C. Ferry Corporation's overall services relating to the Tsawwassen/Swartz Bay and Horseshoe Bay/Nanaimo routes has been studied to form the basis for the above comparison. An evaluation of the ferry services was therefore undertaken as described below:-

4.1.1 Ferry services now provide a sea-link between the Mainland and Vancouver Island. Traffic volumes are growing and if they are to be accommodated then the ferry services will have to be continually expanded. This necessitated the preparation of an investment plan for the B.C. Ferry Corporation to determine how many new ships would be required, how many new terminals and berths would be needed, and the number of crossing routes that will be necessary in the years up to 2015.

4.1.2 Such planning was predicated on the forecast growth of traffic - assuming continued ferry services across the Strait of Georgia. The growth pattern which was chosen was:-

	Automobile Equivalent Spaces	No. of Fare-Paying Passengers
1970	1,750,000	-
1975	2,600,000	-
1980	3,200,000	8,200,000
1985	4,700,000	12,000,000
1990	6,900,000	17,600,000
1995	8,500,000	21,700,000
2000	10,000,000	25,500,000
2005	11,500,000	29,300,000
2010	13,000,000	33,200,000
2015	14,500,000	37,000,000

The actual increase in vehicular traffic from 1970 to 1980 was 83%. The forecast from 1980 to 1990 is 115%.

4.1.3 Plans for expansion of the ferry services included the following:

(i) adding an extra deck to the existing "stretched" class of ships to increase their carrying capacity;

(ii) increasing the number of ships in service such that the size of the ferry's fleet would be as follows for the Strait of Georgia crossings:-

	No. of Ships in Service
1980	10
1985	10
1990	14
1995	17
2000	19
2005	21
2010	24
2015	26

(iii) a new Mainland terminal to be in service in 1988

(iv) a new Vancouver Island terminal to be in service in 1994

(v) a fourth crossing route between two more terminals to be in service in 2012

(vi) the schedule of capital costs to pay for these facilities would be as follows:-

	Added Decks	New Ships	Terminal Costs	Approaches	Total
		in $ Millions			
1982-1989	$60	$105	$100	$ 25	$290
1990-1994	-	135	100	25	260
1995-1999	-	180	-	-	180
2000-2004	-	75	-	-	75
2005-2009	-	75	-	-	75
2010-2015	-	90	200	50	340
TOTALS	$60	$660	$400	$100	$1220

- to which must be added $6 million for improved terminal facilities at Departure Bay, Nanaimo in 1980 and an estimated $65 million in 1981 for alterations to the Tsawwassen and Swartz Bay terminals for servicing the ships that have been given an added deck.

4.1.4 A fare structure of $11.00 per vehicle and an average passenger revenue of $3.30 in 1980/81 prices was assumed for the study period upto 2015.

4.1.5 The operating costs of the ferry service were estimated and when deducted from the gross revenues, gave rise to a stream of net revenues over the period to 2015.

4.1.6 It was therefore possible to relate the stream of net revenues from ferry operations to the stream of needed investment costs in ships and terminals. Both "streams" were then discounted to present-day values and this indicated that the internal rate of return on the new investment capital would be about 5%.

4.1.7 Subsidy payments by the Government to the B.C. Ferry Corporation were excluded from the study since the same rationale for paying these exists whether a ferry service is in operation or a Fixed-Link is built. In any event, the amount of subsidy paid to the Corporation for these two routes is only small in relation to the total subsidy paid which arises primarily from all the other ferry routes. While this subject is irrelevant to this study, it is an opportune time to point out that the subsidies to be paid by the Government for ferry services will change hardly at all if a Fixed-Link is built.

4.2 A Fixed-Link

The conditions under which a Fixed-Link were evaluated are given below:-

4.2.1 It was assumed for technical reasons that the Fixed-Link would be for vehicular traffic only.

4.2.2 The time taken to make the crossing using a Fixed-Link would on average be about 1½ hours less than by ferry for a one-way crossing.

4.2.3 It was assumed that a toll would apply to the Fixed-Link at the same rates as those charged for a ferry crossing.

4.2.4 The time savings would generate additional traffic over and above the projections applicable to ferry traffic; it was estimated that the traffic volumes would be 25% higher by Fixed-Link than by ferry.

4.2.5 Based upon these higher traffic volumes and the toll fees, it was calculated that the internal rate of return on the Fixed-Link capital investments would be about 3.5% compared to a comparable internal rate of return on new ferry investments of about 5%.

4.2.6 This comparison by itself is not conclusive and it is necessary to review the factors that entered into this evaluation.

5. A Review of the Important Factors

5.1 Affecting the Fixed-Link:

The significant factors that have a bearing on the evaluation of a Fixed-Link are summarized below:-

5.1.1 The Toll on a Fixed-Link Crossing

It might be possible to raise the toll beyond that indicated in the study in order to increase total revenues; but likewise the fare on the ferries could also be raised.

5.1.2 The Projected Traffic Volumes

If higher estimates of new traffic using a Fixed-Link crossing than the traffic volume using the ferries were used, then this would increase the revenue earning potential of a Fixed-Link.

5.1.3 Time Savings

A valuation of the net benefits of the time saved by people through being able to make faster crossings has not been included in the results of the study. This factor may be more significant than by simply recognizing it as a factor contributing to the increase in traffic.

5.1.4 The Cost of Constructing the Fixed-Link

This is a significant determinant of the economics of a Fixed-Link crossing. Insofar as the actual costs (in 1980 prices) are more likely to be higher than lower (than $3,000 million), a great amount of detailed attention would have to be paid to this factor.

5.1.5 The Operating, Maintenance and Repair Costs of a Fixed-Link Crossing

These need to be carefully assessed. An arbitrary value was inserted in the study analysis pending detailed study.

5.1.6 The Effects of a Fixed-Link Crossing on Regional Economic Development

The effects were taken to be neutral on balance insofar as they might be affected by a Fixed-Link crossing.

5.1.7 Effects upon Maritime Shipping using the Strait of Georgia

The Fixed-Link crossing would lie across a major shipping route. It would have to be engineered so as to avoid disruptions to shipping but more particularly in such a manner as to prevent calamitous collisions between ships and the Fixed-Link.

5.1.8 The Commencement Date for Constructing a Fixed-Link

Starting construction of a Fixed-Link Crossing later, by say five years, improves the economic viability of a Fixed-Link.

5.1.9 Interruptions to Traffic Minimized

Having access between the Lower Mainland and Vancouver Island by road can minimize the disruptions to traffic sometimes occasioned by labour disputes on the ferries.

5.2 Affecting the Ferry Services

The factors that affect ferry services in their comparative evaluation with a Fixed-Link crossing are mostly the same as those indicated above. Special considerations however apply to:-

5.2.1 The conclusions of the comparative evaluation of Fixed-Link vs Ferry Services might be affected if it is not feasible to raise the superstructure of the present "stretched" class of ships.

5.2.2 The comparative evaluation would be affected in favour of ferry services if, by raising the superstructure, a greater carrying capacity for vehicles than indicated in the study, was possible.

5.2.3 One crucial element is the determination of the net revenues accruing from the ferry services. This reflects the difference between the gross revenues (traffic volume x ferry fares) and the operating costs of the ships. In the absence of a detailed study of vessel operating costs over time, an element of arbitrariness was used to "fix" the estimated net revenue earning capacity of the ferry services.

6. The Accuracy of the Values

6.1 All the factors are reviewed in more detail in the succeeding chapters, and values have been assigned to most of them. In any project appraisal covering an extended period of time questions arise as to the reliability of the estimates used. That, "nothing

is certain in the future", is a truism. But it is possible to assign values that, firstly, are directional in their influence; secondly, have relative importance and significance; and thirdly have absolute values that are not unreasonable in their possible accuracy. The assessment of the economics of a Fixed-Link crossing contained in this Report should be viewed in this light.

6.2 An indication of the relative importance of some of the factors is contained in the following table. It is derived from the Base Case used in the study which indicated that at a cost of $3 billion, and a discount rate of 5%, the net present worth of the Fixed-Link project would be negative to the value of $300 million, whereas the ferry system would break even using a 5% discount rate.

		Present Worth Values of		
		Investment Costs	Benefits	Net Present Worth Value
		in millions		in millions
1.	Base Case - Fixed-Link	$2,800	$2,500	- $300
2.	Base Case - Ferry Services	700	700	break-even
3.	Assuming increased traffic	2,800	2,625	- 175
4.	If Time-Saving is valued	2,800	2,750	- 50
5.	If Construction Cost is $4 bn.	3,700	2,500	-1,200
6.	If Construction Cost is $2 bn	1,900	2,500	+ 600
7.	If Project delayed 5 yrs-Cost $3 bn.	2,800	3,000	+ 200
8.	If Project delayed 5 yrs-Cost $4 bn.	3,700	3,000	- 700

7. Conclusions and Recommendations

These are brief enough in their entirety, as contained in Chapter seven of this Report, to ask the reader to turn to that chapter directly.

8. Techniques of Project Appraisal and the Language of Economic Analysis

These are contained in the following appendix to this chapter.

APPENDIX TO CHAPTER 1

Techniques and Terminology of Project Appraisal

1. Project Appraisal

"The literature of project appraisal commonly gives the impression that the goal is to produce a number or set of numbers that tells whether a project is good or bad. In reality, it is not the numbers themselves that are important, but rather the appreciation of the project's relative strengths and weaknesses that is gained in the course of appraising it. The numbers are simply an instrument of discipline that forces the analyst to examine all relevant factors, and as a means of communicating his conclusions to others. The judgment of a seasoned analyst who is sensitive to the major differences between the values of important inputs and outputs may result in a much more accurate measure of the worth of a project than a fancy mathematical method applied by an inexperienced analyst. It is therefore essential to season the quantitive aspects of appraisal with a large measure of common sense."

- John R. Hansen, "Guide to Practical Project Appraisal" United Nations, 1978

2. Methodology

The methodology used in the study has been to compare the attractiveness of building a Fixed-Link crossing with that of continued ferry services.

"Attractiveness" is defined in terms of the net present worth, and is measured by the difference between the benefits and costs of each project.

3. Net Present Worth

The net present worth of a project measures three variables - the benefits, the costs and the length in years of the project.

The benefits are the gross earnings or revenues that arise directly or indirectly from the project plus the value of any savings that accrue from the project.

The costs are cash outflows consisting of operating expenditures and investment capital spent on, for example, ships, terminals, the building of the Fixed-Link.

The time is the period of time over which the projects are to be evaluated usually measured in years. The "stream" of benefits and costs year by year are represented in a time schedule.

An example is:-

	PROJECT X			PROJECT Y		
Year	Benefits ($)	Costs ($)	Net Worth ($)	Benefits ($)	Costs ($)	Net Worth ($)
1	0	500	- 500	1,500	1,200	+ 300
2	0	500	- 500	1,500	1,200	+ 300
3	1,000	4,000	-3,000	1,500	1,200	+ 300
4	3,000	500	+2,500	1,500	1,200	+ 300
5	3,000	500	+2,500	1,000	1,200	- 200
TOTAL	7,000	6,000	+1,000	7,000	6,000	+1,000

Both projects have a life of only five years.

In both five year projects, the benefits and costs are identical over the same period of time. It can be quickly shown that Project Y is a more attractive project than Project X. However if Project X has a life of 10 years and in each of the extra 5 years has net benefits of $2,500 whereas Project Y only had a life of 5 years, then unquestionably Project X is more attractive than Project Y. The length of life of the projects is different and there is a difference in the stream of annual net worth values. A visual examination in the above example indicates which is the preferred project. But most projects are more involved and require a mathematical evaluation using a Discount Rate.

4. The Discount Rate

4.1 In order to make a true comparison between the comparative net worths of two projects, they have to be judged on a common basis in the present. Thus the term - "NET PRESENT WORTH". The discount rate is that rate used to bring net worth values to a net present worth.

4.2 A person given the option of a $1,000 gift now or to be received in five years time will choose now because by the time five years comes the $1,000 received now and invested at 10% interest would be worth $1,610 OR alternatively a gift of $1,000, five years

hence is the equivalent of being given $621 today. At 10% interest an investment of $621 would be worth $1,000 in five years time.

4.3 In the appraisal of a project therefore, it is necessary to convert the two streams of estimated benefits and costs year by year into present worth values and by substracting one from another, arrive at the NET PRESENT WORTH of the project. The conversion into present worth values is accomplished by using a discount rate. In the above examples in paragraph 4.2, a 10% discount rate was used. In the appraisal of the Fixed-Link and Ferry Project, a discount rate of 5% was used. In the example in paragraph 3, by using a discount rate of 10% the two projects X and Y can be evaluated into a comparison of their net present worths as follows:-

At 10% discount rate (5 years life for both projects)

Net Present Worth of Project X is $139

Net Present Worth of Project Y is $826

If Project X has 10 year's life and Y only 5 years:-

Net Present Worth of Project X is $6,025

Net Present Worth of Project Y is $ 826

In order to clarify the working of this example using a discount rate (of 10% in this example) the calculations are shown below:

Project X

	Benefits ($)		Costs ($)	
Year	Actual	Present Worth	Actual	Present Worth
1	0	0	500	455
2	0	0	500	413
3	1,000	751	4,000	3,004
4	3,000	2,049	500	341
5	3,000	1,863	500	311
	7,000	4,663	6,000	4,524

Net Present Worth of Project is $139

Project Y

	Benefits ($)		Costs ($)	
Year	Actual	Present Worth	Actual	Present Worth
1	1,500	1,363	1,200	1,091
2	1,500	1,239	1,200	991
3	1,500	1,126	1,200	901
4	1,500	1,025	1,200	820
5	1,000	621	1,200	745
	7,000	5,374	6,000	4,548

Net Present Worth of Project is $826

5. The Rate of Return

5.1 In the above example, if in the case of Project X the present worths of the benefits and costs had been equal, then the net present worth of the project using a 10% discount rate would have been zero. At that point, the project can be evaluated in terms of having an "INTERNAL RATE OF RETURN" of 10%.

5.2 If the cost of borrowing (capital) is less than 10%, the project would be profitable; if the rate of interest charged on borrowed capital is more than 10%, then the project would be unprofitable.

5.3 The use of a "rate of return" concept in the evaluation of a Fixed-Link crossing was inappropriate in the context of this study since the methodology used for its evaluation was one of comparison with the continued operation of ferry services.

CHAPTER TWO

TRAFFIC FORECASTS

FOR

FERRY CROSSINGS AND A FIXED LINK

CHAPTER 2

TRAFFIC FORECASTS FOR FERRY CROSSINGS AND A FIXED LINK

1. Basis of Forecasts

The basis for estimating the potential traffic on a fixed-link crossing will be the past, present and forecast traffic carried by the B.C. ferries.

2. B.C. Ferry Corporation Past Traffic Volumes

2.1 The following Tables list the actual traffic statistics for the ferry system over the two existing routes, over the years 1975 through 1979. The forecast 1980 traffic is shown for comparison purposes.

Forecasts beyond 1980 are given in Tables 4.1 and 4.2 in paragraph 4.

Route 1 is that between Tsawwassen and Swartz Bay and Route 2 is between Horseshoe Bay and Nanaimo.

Table 2.1

Total Number of Vehicles

Period to 31 March	Route 1	Route 2	Total	Route 1	Route 2	Total
	Total No. of Vehicles			Percentage Incr. Over Prev. Year		
Actual 1975/76	1,310,995	1,027,500	2,338,495			
Actual 1976/77	1,039,763	820,777	1,860,540			
Actual 1977/78	1,129,070	897,210	2,026,280			
Actual 1978/79	1,319,938	1,032,016	2,351,954			
Actual 1979/80	1,399,726	1,176,071	2,575,797	6.0%	14.0%	9.5%
Forecast 1980/81	1,509,000	1,319,000	2,828,000	7.8%	12.2%	9.8%

2.2 The categories of vehicles are:Passenger vehicles under 6'6"; P.V. over 6'6" in height; Trucks over 5500 kgs. GVW: Motor Cycle, Trailers under 6'6"' Trailers over 6'6" in height' Buses - 15 passengers or over. Since this listing includes dissimilar vehicles, the numbers are converted into standard units which are termed AUTOMOBILE EQUIVALENT SPACES (A.E.S.). The vehicle fare throughout this study is related to one A.E.S. Statistics for Automobile Equivalent Spaces are given in Table 2.2.

Table 2.2

Period to 31 March	NO. OF AUTO EQUIVALENT SPACES Route 1	Route 2	Total	PERCENTAGE INCR. OVER PREVIOUS YR. Route 1	Route 2	Total
Actual 1970/71			1,750,000			
Actual 1975/76	1,466,187	1,152,130	2,618,317			
Actual 1976/77	1,184,705	948,395	2,133,100			
Actual 1977/78	1,275,866	1,019,502	2,295,368	7.7%	7.5%	7.6%
Actual 1978/79	1,482,632	1,168,806	2,651,438	16.2%	14.6%	15.5%
Actual 1979/80	1,577,104	1,337,337	2,914,441	6.4%	14.4%	9.9%
Actual Jan.-June 1979	691,400	564,639	1,256,039			
Jan.-June 1980	756,626	637,897	1,394,523	9.4%	13.0%	11.0%
Forecast 1980/81	1,700,000	1,500,000	3,200,000	8.0%	12.0%	10.0%

2.1 Statistics of the total number of passengers carried are given below in Table 2.3. The driver of a vehicle is classified as a passenger on the ship. Non-fare paying passengers are included in this Table. These are primarily young children.

Table 2.3

Period	TOTAL NO. OF PASSENGERS Route 1	Route 2	Total	PERCENTAGE INCR. OVER PREVIOUS YR. Route 1	Route 2	Total
Actual 1975/76	4,046,388	2,654,831	6,701,219			
Actual 1976/77	3,458,303	2,218,346	5,676,649			
Actual 1977/78	3,680,719	2,479,835	6,160,554	6.4%	11.8%	8.5%
Actual 1978/79	4,211,252	2,753,052	6,964,304	14.4%	11.0%	13.0%
Actual 1979/80	4,526,959	3,079,454	7,606,413	7.5%	11.9%	9.2%
Actual Jan.-June 1979	1,891,655	1,242,948	3,134,603			
Jan.-June 1980	2,040,851	1,407,861	3,448,712	7.9%	13.3%	10.0%
Forecast 1980/81	4,900,000	3,480,000	8,380,000	8.0%	13.0%	10.0%

N.B. "Fare-Paying Passengers" are approximately 97% of "Total Passengers".

2.4 A fairly constant relationship between the number of automobile equivalent spaces and numbers of passengers is indicated in the following Table 2.4.

Table 2.4

No. of Passengers per 1 Auto Equivalent Space	No. of Fare-Paying Passengers Per 1 Auto Equivalent Space
Actual 1975 - 2.56	-
Actual 1976 - 2.66	-
Actual 1977 - 2.68	-
Actual 1978 - 2.63	-
Actual 1979 - 2.61	2.54
Forecast 1970 - 2.62	2.55

3. Factors Affecting Ferry Traffic Projections

3.1 Insofar as the factors to be considered in estimating future traffic trends are individually subjective and indeterminate, any consolidation of these factors into some demand growth equation would not result in a more accurate forecast than that which can be obtained from a careful appraisal of all the various factors and a judgemental forecast of the traffic.

3.2 An examination of the factors affecting future demand is therefore necessary in order to determine the traffic projections. The factors are:

3.2.1 Freedom to Expand: An assumption that there will not be an arbitrary restriction of ferry capacity in terms of ships, sailing frequencies, terminal space, etc.

3.2.2. The Fare: It is assumed that the fare for vehicles and passengers will be slightly increased in 1980 prices (now $10.00 per vehicle crossing and $3.00 per passenger/driver); and that this increase would be in the order of 10% for both vehicles and passengers. Such an increase, would have a negligible effect on the traffic volumes crossing between the Lower Mainland and Vancouver Island, and would suffice to ensure that these ferry routes were financially viable even without a government subsidy. Fare increases greater than 10% would probably have a significant effect in reducing total revenue.

3.2.3 Population Projections: Population projections by B.C. Research (Sept. 1979) indicate that the 1979 population for the Province of B.C. of 2,600,000 will rise by 1991 to 3,100,000 and to 3,500,000 by the year 2000, an increase of 35% over 1979.

The Island figures reflect the potential increase in the demand for transport to move off the Island while the Provincial total population figures reflect the growth of traffic demand for movements to Vancouver Island.

As the population increases there will be an added demand for ferry services from the higher population and in addition a given population may want to make more trips per head than before as a function of disposable income.

3.2.4 Personal Disposable Income: Real personal disposable income in British Columbia, in the other parts of Canada. in the U.S., and in the other areas of the world from whence visitors can be expected, eg. Japan, is expected to continue to grow. Part of this growth will be translated into more vehicular traffic and part will be reflected by more passengers only.

3.2.5 Tourism: The growth of personal disposable income, with increased leisure time and longer holidays will stimulate travel demand. Population growth associated with increased urban stress will encourage more visitors to travel to the rural areas of B.C. including Vancouver Island. The latter may be particularly attractive in that the tourists can also enjoy sea voyages. A trend towards more packaged group tours now evident in the tourist industry will result in more passenger trips - especially from abroad - extended to Vancouver Island.

3.2.6 Energy: Substantial increases in the price of gasoline and diesel fuel could affect travel. However, gasoline prices would have to increase very substantially in order to have any significant effect upon travel. Actual shortages may be the most likely deterrent to travel. In time a moral climate may develop that could inhibit the use of the automobile. "In time" is projected to be in the years beyond 1990. However, the likelihood of lower prices for gasoline in Canada than in the U.S. might stimulate travel in B.C. and the easy access by ferry to Vancouver Island would result in increased vehicular traffic.

3.2.7 Inflation: Ferry fares, ferry costs and personal disposable income are all expressed in 1980/81 real terms; but the rise of personal disposable income will result in the ratio of ferry fares to personal disposable income at inflated prices and costs declining thus having the effect of reducing ferry fares in relative terms and thereby stimulating traffic.

3.2.8 Industrial/Commercial Activity on Vancouver Island: Insofar as industrial/commercial activity is likely to continue to grow on Vancouver Island, this will result in more traffic on the ferries.

3.2.9 Improvements in Ferry Services: Newer, faster ships are likely to be placed in service as improved technology and techniques become available, thus saving time, reducing costs, and stimulating traffic.

4. Traffic Projections: B.C. Ferries:

4.1 An assessment of all the above factors indicates the difficulty of translating "possibilities" and "probabilities" into specific forecasts of traffic growth. The best one can achieve is the preparation of a range of traffic forecasts and ultimately selecting one that appears most probable, while at the same time considering the implications on the ferries' development plans should alternative traffic growth patterns occur.

4.2 The following growth models have been considered and the resultant traffic projections measured in auto equivalent spaces are given in Tables 4.1 and 4.2.

4.2.1 Case 1 - based upon the following percentage increases each year:-

1980 -10.0% increase over 1979
1981 through 1990 - 8.0% increase per annum over preceding year.
1991 through 2000 - 6.0% increase per annum over preceding year.
2001 through 2010 - 4.0% increase per annum over preceding year.
2011 through 2015 - 2.0% increase per annum over preceding year.

4.2.2 Case 2 - based upon the following percentage increases each year:-

1980 -10.0% increase per annum over preceding year.
1981 through 1990 - 8.0% increase per annum over preceding year.
1991 through 2000 - 7.0% increase per annum over preceding year.
2001 through 2010 - 5.0% increase per annum over preceding year.
2011 through 2015 - 3.0% increase per annum over preceding year.

4.2.3 Case 3 - based upon a constant numerical growth each year similar to past growth trends.

4.2.4 Case 13 - based upon a combination of Cases 1 and 3 in which the percentage annual increases shown in Case 1 take place from 1980 through 1991, but thereafter a constant numerical growth occurs each year similar to that shown in Case 3.

4.3 Forecast Traffic of Auto Equivalent Spaces

The above models result in the following traffic projections in terms of auto equivalent spaces:-

Table 4.1

Auto Equivalent Spaces - Strait of Georgia Crossing Routes

Year	Case 1	Case 2	Case 3	Case 13
1970	1,750,000	1,750,000	1,750,000	1,750,000
1975	2,600,000	2,600,000	2,600,000	2,600,000
1980	3,200,000	3,200,000	3,200,000	3,200,000
1985	4,700,000	4,700,000	4,700,000	4,700,000
1990	6,900,000	6,900,000	6,200,000	6,900,000
1995	9,200,000	9,700,000	7,700,000	8,500,000
2000	12,400,000	13,600,000	9,200,000	10,000,000
2005	15,000,000	17,300,000	10,700,000	11,500,000
2010	18,300,000	22,100,000	12,200,000	13,000,000
2015	20,200,000	25,600,000	13,700,000	14,500,000

(Annual Projections are tabulated in Table 4.1.1 and graphed in Figure 4.1).

4.4 An assessment of these four cases would indicate that Case 2 reflects an improbable increase in traffic growth i.e. from 3,200,000 in 1980 to 13,600,000 in 2000 and to 25,600,000 by 2015. None of the factors earlier reviewed support this large growth pattern.

All the above projections (except Case 3) recognize a more than two-fold increase from 3,200,000 A.E.S. in 1980 to 6,900,000 by 1990 - i.e. an increase of 115%. In the ten years from 1970 to 1980, the actual percentage increase was 83% so that a traffic forecast greater than 6,900,000 in 1990 would seem improbable. If the increase however, is less than forecast, (i.e. to 6.9 million A.E.S.) then the plans of the Ferry Corporation can be adjusted (delayed) accordingly.

In the instance of Case 3, the traffic growth from 1980 to 1990 up to 6,200,000 A.E.S. represents an increase of 94%. This may be the most realistic forecast but as mentioned above, it is wise to prepare plans for a slightly larger growth so long as they are based upon not-unreasonable forecasts; if necessary they can be scaled down if the occasion justifies it.

All planning therefore, with respect to the future operations of the B.C. Ferry Corporation will be predicated on Case 13.

4.5 Forecast Passenger Traffic

The above projections referred only to auto equivalent spaces. Based upon past statistics, (Table 2.4) these can be transformed into numbers of fare-paying passengers using a ratio of 2.55 passengers for each auto equivalent space. These are shown below in Table 4.2. The projections by year in detail are given in Table 4.2.1.

Table 4.2

Projected Numbers of Fare Paying Passengers

Case 13

	Fare-Paying Passengers
YEAR	Case 13
1979	7,400,000
1980	8,200,000
1985	12,000,000
1990	17,600,000
1995	21,700,000
2000	25,500,000
2005	29,300,000
2010	33,200,000
2015	37,000,000

4.6 Peak Traffic Flows: For ferry planning purposes, the peak traffic flows are more significant than annual projections. These are therefore, analysed in the following tables:-

Table 4.3

Peak Months - Auto Equivalent Spaces (AES)

	JULY			AUGUST					
Year	Route 1	Route 2	Total	Route 1		Route 2		Total	
1977	161,574	130,852	292,426	172,387	(54.8%)	142,408	(45.2%)	314,795	(100%)
1978	184,292	145,465	329,757	197,618	(56.0%)	155,058	(44.0%)	352,676	(100%)
1979	200,707	167,375	368,082	186,803		170,306		357,109	(*)

* Percentages for 1979 are not given since the accident to the M.V. "Queen of Alberni" in August 1979 distorted the traffic pattern.

Table 4.4

Annual Totals (AES)	Route 1	Route 2	TOTAL
1977	1,275,866	1,019,502	2,295,368
1978	1,482,632	1,168,806	2,651,438
1979	1,577,106	1,337,337	2,914,441

Table 4.5

Percentages of Peak Month of August to Annual Totals

	July			August		
Year	Route 1	Route 2	Total	Route 1	Route 2	Total
1977	12.66%	12.83%	12.74%	13.51%	13.97%	13.71%
1978	12.43	12.45	12.44	13.33	13.27	13.30
1979	12.73	12.52	12.63	11.84	12.73	12.25*

* The August 1979 figures were distorted due to the accident to the M.V. "Queen of Alberni".

For purposes of forecasting the peak month's traffic in future years, a percentage of 13.3% will be used.

4.7 Using the projected vehicle traffic in auto equivalent spaces in Cases 1 and 13, and based upon an average of the five peak days in the peak month of 1979 being 14.2% above the average day's traffic in the month, the peak traffic projections are as follows:

Table 4.6

	Annual Traffic		Peak Month		Daily Peaks*	
Year	Case 1	Case 13	Case 1	Case 13	Case 1	Case 13
	In Auto Equivalent Spaces					
1980	3,200,000	3,200,000	426,000	426,000	15,700	15,700
1985	4,700,000	4,700,000	625,000	625,000	23,000	23,000
1990	6,900,000	6,900,000	917,000	917,000	34,000	34,000
1995	9,200,000	8,500,000	1,224,000	1,130,000	45,000	42,000
2000	12,400,000	10,000,000	1,650,000	1,330,000	61,000	49,000
2005	15,000,000	11,500,000	1,995,000	1,530,000	73,000	56,000
2010	18,300,000	13,000,000	2,434,000	1,729,000	90,000	64,000
2015	20,200,000	14,500,000	2,687,000	1,929,000	99,000	71,000

(0.00489 of Annual Traffic)

5. Traffic Projections for a Fixed-Link Crossing

5.1 The factors affecting the traffic on a fixed-link crossing are those already referred to above in paragraph 3 namely, fares, population growth, personal disposable income, tourism, energy conservation, inflation and industrial/commercial activity on Vancouver Island. To these must be added convenience and a saving in crossing-times. Further views on these topics with particular regard to a fixed-link crossing instead of a ferry-crossing are as follows:

5.2 Fares: Setting tolls on "the bridge" is determined by government policy. A toll-free crossing would have enormous effects on the potential traffic, on the industrial/commercial activity on Vancouver Island, and on the living (residential and tourist) pattern of people both on the Mainland and on Vancouver Island. The cost of the fixed-link would have to be borne by the people of the Province as a whole out of general taxation. A cost-benefit analysis of the effects of a toll-free crossing would be a very extensive exercise, and is not attempted here. Instead, it will be assumed that a fixed-link crossing would be built and operated on a user-pay principle.

If the tolls are set at a level significantly higher than the present ferry fares, then notwithstanding the possible savings in travel time (discussed below in paragraph 5.8), the volume of traffic can not be expected to be higher than the forecast ferry traffic, and might possibly (probably) be lower.

If the tolls are made the same as the ferry fares and if the travel time is reduced, then there will probably be some increase in traffic volumes, in the order of 25% more than the forecast ferry traffic. A toll at current fare levels would be significantly more of an influence on traffic volumes than possible time savings.

If the tolls are set below the present level of ferry fares, then an even larger volume of traffic will result. It is apparent, however, that as long as some level of toll is established, say at least as high as half the current ferry fare, a free flow of unrestricted traffic will not occur, such as might cause people to drive over to Vancouver Island as they might take a day's drive to Manning Park or along Howe Sound to Squamish and Whistler. A numerical example will illustrate the significance of this.

If there are five million vehicles annually that will pay to make the crossing at $10 each, the revenue would be $50 million. If however, one reduces the fare by one half to $5 each and this doubles the traffic to ten million vehicles annually, the revenue will remain unchanged at $50 million.

If would seem improbable that a doubling of a ferry's projected traffic volumes would occur given a lower fare structure - and as shown above, this would not necessarily lead to higher total revenues.

5.3 Population Growth: A fixed-link would not affect total population growth and given a user-pay principle there would not be a significant change in the pattern of regional population growth. One can rule out as very unlikely any increased traffic potential from commuting between dormitory residences on the Island and the Vancouver area. Some additional traffic may result from a few more weekend residences on Vancouver Island but the bridge toll will still remain a deterrent to most people.

5.4 Personal Disposable Income: This will have no more effect on traffic volumes than has already been built into the ferry system's forecast volumes.

5.5 Tourism: It is doubtful if the added tourist attractions of making a crossing to the Island by a fixed-link bridge would outweigh the loss of tourist attraction by not being able to cross through the Gulf Islands by ferry. One can assume that even with a Fixed-Link Crossing, there will still remain some ferry service between Tsawwassen and Swartz Bay and that in the summer months this will absorb many travellers.

5.6 Inflation: This would have no greater effect on traffic volumes by a fixed-link than by ferry.

5.7 Industrial/Commercial Activity on Vancouver Island: Unless it can be demonstrated that a fixed-link crossing would effect significant reductions in transport costs and a noticeable savings in time, the effect of a fixed-link crossing on industrial/commercial activity on Vancouver Island would be negligible.

5.8 Time-Savings: Since it is not known where the terminals of a Fixed-Link would be on either the Lower Mainland or on Vancouver Island, it is not practicable to attempt any detailed analysis of the savings in travel time. Nevertheless, certain broad conclusions can be reached based upon the following:-

5.8.1 A fixed-link would have a terminal on Vancouver Island in the general area of Ladysmith/Duncan, and on the Lower Mainland between Iona and Roberts Bank.

5.8.2 The average loading, sailing and unloading times via ferry are:-

on Route 1 - 117 minutes
on Route 2 - 125 minutes

The average annual waiting time to board a ferry (routes 1 & 2) is 30 minutes (about 60 minutes on average during the peak summer months - although obviously much longer waits occur during peak hours on peak days).

5.8.3 Deduced from the above, it is estimated that the average time taken to cross by ferry is about 2½ hours for both routes. If an extra ½ hour per trip is allowed on average to allow for the psychological belief that it takes longer, and to cater for the reality of longer times during peak periods then, the ferry time becomes 3 hours per crossing.

5.8.4 The estimated travel time by a fixed-link is 40 minutes to cover an approximate road distance of 40 kms. @ 60 k.p.h. - say 3/4 hour.

5.8.5 It is assumed that the time taken to reach the terminal on the Mainland will be about the same as the time taken to reach the Mainland ferry terminals but possibly ¼ hour longer to allow for the extra time incurred by people previously using Horseshoe Bay. Since the terminal on Vancouver Island will be inbetween Victoria and Nanaimo, it is estimated that there will be an added time per trip of about ½ hour on the Island Highway. This time may be longer if the Malahat Highway is not improved and if traffic is slowed by difficulties on that section of the road in Winter by ice and fog.

5.8.6 It should be noted also that the annual average crossing time by a fixed-link may be extended if the fixed-link has to be closed to permit shipping through it or because bad weather disrupts traffic on the open-bridge. No value is assigned to either eventuality though one or both are likely to occur.

5.8.7 In summary then, an average time saving of about 1½ hours per crossing via the Fixed-Link is deduced.

5.8.8 Two questions arise:-

(a) Will this time savings per trip generate additional traffic? and

(b) Can some value be adduced to the total annual time savings?

(i) Some additional traffic can be expected, especially from people who have been deterred by the belief (whether realistic or not) that their journeys would be subject to delay in boarding a ferry. With a round-trip saving of three hours it is also anticipated that many of the travellers now flying between Vancouver and Victoria would switch to road. In the belief that a ferry service would be retained between Tsawwassen and Swartz Bay during the Summer months, it is also likely that some tourist traffic would prefer the sea crossing and that this traffic would not use the fixed-link. However, in Chapter 5 it was assumed for the purposes of this study, that all ferry services between Tsawwassen and Swartz Bay would cease.

(ii) It is extremely difficult to arrive at a meaningful value of the total time savings. Obviously, the value is positive even after discounting the lost value to many tourists of crossing by road instead of by sea, and even after allowing for the fact that the time saved to tourists is not very significant in their total holiday-schedule. Whatever value can be attached to time savings would have to be related to an estimate of the total estimated increase in productive time resulting from the quicker journeys, and giving an hourly value to that time. Consideration of this "value" is deferred to Chapter 5, paragraphs 3.5 and 3.6.

5.9 Summary Traffic Projections: Taking into consideration all the factors referred to above in the preceding paragraphs, it is not thought likely that the traffic using a Fixed-Link crossing would exceed the forecast traffic using the ferries by more than 25%, assuming a crossing toll equivalent to that charged by the B.C. Ferry Corporation.

The resultant traffic projections are contained in the following Table 5.1 based upon the Case 13 forecast for ferry traffic summarized in Tables 4.1 and 4.2 and detailed in Tables 4.1.1 and 4.2.1.

Table 5.1

Projected Traffic on Fixed-Link Crossing

	No. of Stand. Size Vehicles*	No. of Passengers
Year	Case FL-13/25%	Case FL-13/25%
1985	5,875,000	15,000,000
1990	8,600,000	22,000,000
1995	10,600,000	27,000,000
2000	12,500,000	32,000,000
2005	14,500,000	36,000,000
2010	16,000,000	41,000,000
2015	18,000,000	46,000,000

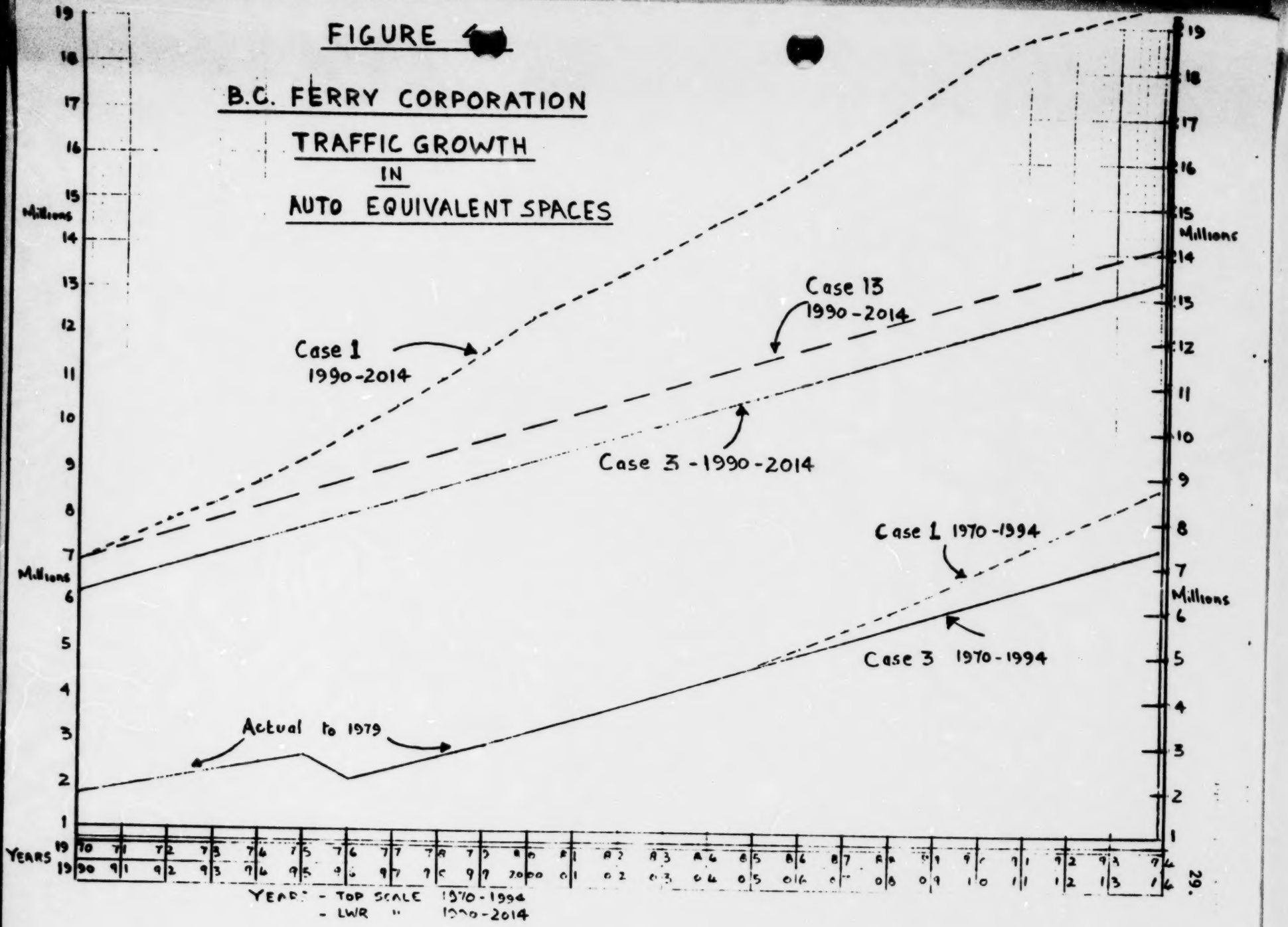
* The vehicular projection in terms of Standard Size Vehicles is based upon the number of Auto Equivalent Spaces used in the B.C. Ferry Corporation's forecasts. It, therefore, envisages that a large commercial truck would be the equivalent in terms of a toll charge to a number of standard size vehicles (measured either by length or gross vehicle weight).

5.10 Obviously, numbers greater or smaller than those shown above in Table 5.1 can be used, but a sense of unreality creeps in if more extreme forecasts are considered and compared with the 2,914,441 automotive equivalent spaces and 7,400,000 fare paying passengers actually carried on the ferries during 1979.

FIGURE 4

B.C. FERRY CORPORATION

TRAFFIC GROWTH IN AUTO EQUIVALENT SPACES



B.C. FERRY CORPORATION

Routes 1 & 2 Traffic Growth and Revenue Forecasts

TABLE 4.1.1

Auto Equivalent Spaces

	Case 1 Millions		Case 2 Millions		Case 3 Millions	Case 13 Millions
1979	2.9	*	2.9	*	2.9	2.9
1980	3.2	10%	3.2	10%	3.2	3.2
1981	3.5	8	3.5	8	3.5	3.5
1982	3.7	8	3.7	8	3.8	3.7
1983	4.0	8	4.0	8	4.1	4.0
1984	4.4	8	4.4	8	4.4	4.4
1985	4.7	8	4.7	8	4.7	4.7
1986	5.1	8	5.1	8	5.0	5.1
1987	5.5	8	5.5	8	5.3	5.5
1988	5.9	8	5.9	8	5.6	5.9
[illegible]9	6.4	8	6.4	8	5.9	6.4
1990	6.9	8	6.9	8	6.2	6.9
1991	7.3	6	7.4	7	6.5	7.3
1992	7.8	6	7.9	7	6.8	7.6
1993	8.2	6	8.5	7	7.1	7.9
1994	8.7	6	9.0	7	7.4	8.2
1995	9.2	6	9.7	7	7.7	8.5
1996	9.8	6	10.4	7	8.0	8.8
1997	10.4	6	11.1	7	8.3	9.1
1998	11.0	6	11.9	7	8.6	9.4
1999	11.7	6	12.7	7	8.9	9.7
[illegible]0	12.4	6	13.6	7	9.2	10.0
2001	12.9	4	14.3	5	9.5	10.3
2002	13.4	4	15.0	5	9.8	10.6
2003	13.9	4	15.7	5	10.1	10.9
2004	14.5	4	16.5	5	10.4	11.2
2005	15.0	4	17.3	5	10.7	11.5
2006	15.6	4	18.2	5	11.0	11.8
2007	16.3	4	19.1	5	11.3	12.1
2008	16.9	4	20.1	5	11.6	12.4
2009	17.6	4	21.1	5	11.9	12.7
2010	18.3	4	22.1	5	12.2	13.0
2011	18.7	2	22.8	3	12.5	13.3
2012	19.0	2	23.5	3	12.8	13.6
2013	19.4	2	24.2	3	13.1	13.9
2014	19.8	2	24.9	3	13.4	14.2
2015	20.2	2	25.6	3	13.7	14.5

TABLE 4.2.1

Fare-Paying Passengers ∅

	Case 1 Millions	Case 2 Millions	Case 3 Millions	Case 13 Millions
1979	7.4	7.4	7.4	7.4
1980	8.2	8.2	8.2	8.2
1981	8.9	8.9	8.9	8.9
1982	9.4	9.4	9.7	9.4
1983	10.2	10.2	10.5	10.2
1984	11.2	11.2	11.2	11.2
1985	12.0	12.0	12.0	12.0
1986	13.0	13.0	12.8	13.0
1987	14.0	14.0	13.5	14.0
1988	15.1	15.1	14.3	15.1
[illegible]9	16.3	16.3	15.0	16.3
1990	17.6	17.6	15.8	17.6
1991	18.6	18.9	16.6	18.6
1992	19.9	20.1	17.3	19.4
1993	20.9	21.7	18.1	20.1
1994	22.2	23.0	18.9	20.9
1995	23.5	24.7	19.6	21.7
1996	25.0	26.5	20.4	22.4
1997	26.5	28.3	21.2	23.2
1998	28.1	30.3	21.9	24.0
1999	29.8	32.4	22.7	24.7
[illegible]0	31.6	34.7	23.5	25.5
2001	32.9	36.5	24.2	26.3
2002	34.2	38.3	25.0	27.0
2003	35.4	40.0	25.8	27.8
2004	37.0	42.1	26.5	28.6
2005	38.3	44.1	27.3	29.3
2006	39.8	46.4	28.1	30.0
2007	41.6	48.7	28.8	30.8
2008	43.1	51.3	29.6	31.6
2009	46.9	53.8	30.3	32.4
2010	46.7	56.4	31.1	33.2
2011	47.7	58.1	31.9	33.9
2012	48.5	59.9	32.6	34.7
2013	49.5	61.7	33.4	35.4
2014	50.5	63.5	34.2	36.2
2015	51.5	65.3	34.9	37.0

∅ 2.55 fare-paying passengers per 1 Auto Equivalent Space.

* Percentage annual increase over preceding year.

CHAPTER THREE

A SIMULATED GROWTH MODEL

FOR

FERRY SERVICES BETWEEN

THE LOWER MAINLAND AND VANCOUVER ISLAND

CHAPTER 3

A Simulated Growth Model for Ferry Services Between the Lower Mainland and Vancouver Island

1. Introduction

1.1 The economics and financial viability of building a Fixed-Link crossing between the Lower Mainland and Vancouver Island is to be measured against the continuing operations of ferry services by the British Columbia Ferry Corporation. Other means are feasible but are not considered to be an economic alternative in today's technology, though they may have a role as an adjunct to the main mode.

1.2 If we consider that a Fixed-Link crossing once built will be in place in perpetuity only requiring continuous repairs and maintenance, then it is necessary to review the long-term plans for a ferry system that will ensure its continuous operation. In this way, the two systems can be compared and evaluated.

1.3 The time period to be analysed for ferry services is to the year 2015 i.e. over a span of about 30 years in relation to a Fixed-Link crossing. Such a "Fixed-Link" could continue in operation indefinately given no mishaps. However even one serious mishap could invalidate an economic analysis that favoured a Fixed-Link. Even apart from these considerations however, the comparative economics of the fixed-link route and the ferry system are unlikey to be affected significantly whether one uses a 30, 40, or 50 year period. Nevertheless, the question of the time-span will be reviewed again. (in Chapter 6, paragraph 6.2.8)

1.4 In the paragraphs that follow a scenario for the growth of the Ferry System across the Strait of Georgia will be developed. It is to be noted that while the B.C. Ferry Corporation provides services to many routes in British Columbia, the scenario for which is developed below relates only to the Tsawwassen/Swartz Bay and Horsehsoe Bay/Nanaimo services and is abstracted from the overall operations of the Corporation. While there is some overlap in the route structures and allocation of ships between the routes, it is not considered to be so significant that it would invalidate the broadly constructed growth model that follows. It should be noted also that the model uses the names of existing ships. This is simply to help the understanding of and give personality to the model. Within a class of ships, such as the "Stretched"Class, it is not important whether the MV "Queen of Vancouver" is the actual ship to be modified first or the MV "Queen of Esquimalt". That would be an operational question only for the Corporation to decide.

2. Background

The study will consider the following factors and assumptions:-

2.1 Continuation of the present ferry crossing routes which are:-

Route 1 - Tsawwassen/Swartz Bay

Route 2 - Horseshoe Bay/Nanaimo

2.2 The addition of more berths to the above terminals.

2.3 The building of new terminals on the Lower Mainland and Vancouver Island as required and the construction of the auxiliary approaches to these terminals.

2.4 The following terminal capacities:-

- at Tsawwassen, Swartz Bay, Nanaimo and all new terminals: - one departure every half-hour.
- at Horseshoe Bay: - one departure every hour in the Horsehoe Bay/Nanaimo service.

2.5 During a 16 hours working day, the capacity of each ship is four return crossings, i.e. eight single one-way crossings per day. It is assumed too that this would apply to any new routes that are developed between the Mainland and Vancouver Island, though obviously if shorter routes were developed and/or faster ships put in service, the number of possible crossings per day would be higher.

The maximum potential capacity at the terminals is therefore:-

With ½ hour departures - 32 per day from each terminal

With 1 hour departures - 16 per day from each terminal

2.6 The number of ships required to service one crossing-route in a 16 hour day at maximum capacity is therefore:-

With ½ hour sailings = 8 ships

With 1 hour sailings = 4 ships

2.7 The availability of ships and terminals and the frequency of departures shall be such that the services provided (scheduled and supplementary) shall be sufficient (i) to be able to carry the daily traffic during the peak month of the year, and (ii) shall be sufficient to carry the traffic during the peak days of that peak month. The traffic on the peak days is measured by taking an average of the traffic carried on five peak days of highest traffic volumes in that peak month. (Statistically this was 0.489% of the total annual traffic in 1979 or 14.2% above the average day in the peak month of 1979).

While this represents a high performance standard, it is not obviously the highest that could be provided measured by the Corporation always having capacity to carry every vehicle at all hours during a day every month of the year.

2.8 An assumption that the present "Stretched" ships in the fleet can be altered by raising their superstructure and adding another deck thus increasing their vessel capacity from 192 equivalent vehicle spaces to 290; at an estimated cost of $10 million per ship; and that the work can be completed within one year for each ship; and that two ships can be so modified in any one year.

2.9 The assumption that one new "C" Class ship will be built and in operation in 1981 and a second in 1982 (there is 60% assurance that in reality both new "C" Class ships will be in service by August 1981.

3. Traffic Growth

3.1 A number of scenarios of the projected growth of traffic (in terms of Automobile Equivalent Spaces) were established in the previous chapter. Two of them, Cases 1 and 13 are summarised in the following Table 3.1.

Case 13 was selected as the best estimate while Case 1 covered a high growth situation.

The peak days' traffic is shown alongside the annual forecasts since these are the critical factor in determining the number of ships to be placed in service.

Table 3.1

SUMMARY TRAFFIC FORECASTS

	CASE 1		CASE 13	
YEAR	ANNUAL	PEAK DAYS	ANNUAL	PEAK DAYS
	in Automobile Equivalent Spaces			
Actual 1979	2,900,000		2,900,000	
Forecast 1980	3,200,000	15,600	3,200,000	15,600
Forecast 1985	4,700,000	23,000	4,700,000	23,000
Forecast 1990	6,900,000	34,000	6,900,000	34,000
Forecast 1995	9,200,000	45,000	8,500,000	42,000
Forecast 2000	12,400,000	61,000	10,000,000	49,900
Forecast 2005	15,000,000	73,000	11,500,000	56,000
Forecast 2010	18,300,000	89,000	13,000,000	64,000
Forecast 2015	20,200,000	99,000	14,500,000	71,000

It is to be noted that the forecast growth rates in both Case 1 and Case 13 are identical to and including 1990, both assuming an annual percentage growth of 8% (compounded).

3.2 The above forecasts are detailed on an annual basis in Table 3.2 for the years 1980 through 1988 and in Tables 3.3 and 3.4 for all the years 1980 through 2015 for Case 1 and Case 13 respectively.

3.3 These Tables also indicate the required expansion of the Corporation's shipping fleet to meet the anticipated traffic, and are further extended in Table 3.3.1 and Table 3.4.1 to show the annual capital outlays required to purchase new ships, build new terminals and construct the access routes to the new terminals.

4. Summary Findings

4.1 The implications of having to build a fleet of ships capable of meeting the peak days' traffic in the peak month of every year are that:-

(a) for most of the year many ships will be under-utilized and many idle.

(b) there will be a higher capital investment in ships than if a lesser criteria for meeting peak days' traffic was adopted.

(c) the annual operating costs will be higher and the financial performance of the ferry system on the Strait of Georgia crossings will be poorer than if a lesser criteria for meeting peak days' traffic was adopted.

The purpose of establishing such a relatively high criteria, i.e. providing services to carry the average daily traffic during the five peak days of the peak month, is to be able to compare the economics of a ferry system with the economics of a fixed-link crossing in which both systems are closely comparable in meeting the traffic demand.

4.2 The number of ships now in service and their use between Routes 1 (Tsawwassen/Swartz Bay) and Route 2 (Horseshoe Bay/Nanaimo) is listed in Table 3.2. Adequate capacity is available for this year. Next year at least one of the two new 'C' Class ships now building, will be in service (probably both). The 'C' Class ships each have a carrying capacity equivalent to 360 auto equivalent spaces (A.E.S.). These will provide sufficient capacity to permit one of the "Stretched" Class of ships with a capacity of 192 A.E.S. to be taken out of service and its superstructure raised to add another deck to give a vessel capacity for 290 A.E.S.

The schedule for modifying six "Stretched" class of ships would therefore be:-

Queen of Vancouver - 1982
Queen of Saanich - 1983
Queen of Esquimalt - 1983
Queen of Victoria - 1984
Queen of Burnaby - 1984
Queen of Nanaimo - 1985

(the actual ships to be modified in any year would not necessarily be in the above sequence).

(there is also a seventh "stretched" ship - the "Queen of New Westminster" - not presently serving Routes 1 and 2 that could also be "raised").

In this growth model and scenario the "Stretched" Class of ships now in service built in 1962/65 with the deck added in 1982/85, are planned for retirement and sale in 1994/97 after providing 12 years of service with the added deck. In physical terms, their life can be much longer than this but it is expected that economic obsolescence will justify their retirement and replacement by more economic ships.

4.3 A new "C" Class of ship or new Class ship or a second Alberni (truck) class ship will be required to be in service in 1987 and another ship the following year. These new ships, first of a sequence of needed new ships, would have to be built in 1985/86 and ordered in 1984.

4.4 The fleet expansion plan indicates that by 1987 there will be 12 ships in service - 8 operating out of Tsawwassen and Swartz Bay, and 4 out of Horseshoe Bay and Nanaimo. These terminals will then be at full capacity. It will, therefore, be necessary to build a new Lower Mainland terminal to be <u>in service</u> in 1987/88. A proposed programme of terminal expansion is:

(i) Tsawwassen to Swartz Bay (now in service)
(ii) Horseshoe Bay to Nanaimo (now in service)
(iii) A new Lower Mainland Terminal (1987/88) to Nanaimo (existing terminal)
(iv) The new Lower Mainland Terminal to a new Vancouver Island Terminal (1994)
(v) Another new Lower Mainland Terminal to another new Vancouver Island Terminal (both in 2012).

The addition of another new terminal on Vancouver Island would not be necessary until 1994 based upon the Case 13 traffic growth, with construction taking place in 1992/93.

A completely new fourth crossing route with new terminals on both sides would not then be required until 2012 (to be built in 2010/11) based upon the Case 13 traffic projections.

The critical significance of the growth of traffic forecasts is seen if the high growth Case 1 forecasts are used. Under this traffic pattern, the fourth crossing route would be required by 1999 (2012 for Case 13 traffic), a fifth crossing in 2007 and a sixth shortly after that - about 2015).

4.5 A schedule of the number of ships in service at selected years is given in the following table:-

Table 4.1

	Case 13	Case 1
1980	10 ships	10 ships
1985	10 ships	10 ships
1990	14 ships	14 ships
1995	17 ships	18 ships
2000	19 ships	22 ships
2005	21 ships	26 ships
2010	24 ships	32 ships
2015	26 ships	35 ships

4.6 A schedule of the investment capital required to pay for the addition of a deck, building the new ships and constructing new terminals and approaches is given in the following table relating to both the Case 1 and 13 traffic projections:-

Table 4.2

Case 13 Traffic Growth

	Adding Decks	New Ships	Terminal Costs	Approaches	Total
			in $ Millions		
1982-1989	$60	$105	$100	$ 25	$ 290
1990-1994	-	135	100	25	260
1995-1999	-	180	-	-	180
2000-2004	-	75	-	-	75
2005-2009	-	75	-	-	75
2010-2015	-	90	200	50	340
TOTALS	$60	$660	$400	$100	$1220

Case 1 Traffic Growth

	Adding Decks	New Ships	Terminal Costs	Approaches	Total
1982-1989	$60	$105	$100	$ 25	$ 290
1990-1994	-	180	100	25	305
1995-1999	-	240	200	50	490
2000-2004	-	135	-	-	135
2005-2009	-	150	200	50	400
2010-2015	-	90	-	-	90
TOTALS	$60	$900	$600	$150	$1710

The time pattern of capital investments is particularly significant in determining the present worth on a discounted basis of a flow-over-time of future costs (and benefits).

4.7 The actual timing of investments may differ from the pattern indicated above because:-

(i) Traffic growth may be more or less than forecast in Case 13. It is unlikely that it would be as high as shown in Case 1 and even more unlikely that it would be higher.

(ii) The analysis was predicated on using ferries of the "C" Class with a capacity of 360 vehicle spaces over the period of the study. It is possible that more advanced design ships would come into operation that could carry more vehicles and be faster. This would result in the saturation point of the terminals being later than planned, with fewer ships being required at a lesser cost and lower operating costs.

(iii) More of the present fleet of "Stretched" ships may be re-engined to give extra speed and reliability.

(iv) It may prove economical to retain some of the "Stretched" Class of ships with an added deck beyond their forecast retirement age.

4.8 The simulated investment schedule indicates that the addition of a fourth ferry crossing will provide for the growth of traffic to beyond 2015 possibly to 2025 using Case 13 traffic projections.

4.9 It should be noted that the year 2015 is thirty-five years hence and the net benefits and costs of events that length of time distant when discounted to present-worth values are much reduced and not of great economic significance in the current study.

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A Simulated Fleet Ex

NAME OF SHIP & YEAR BUILT	AVAILABLE CAPACITIES PER DAY & NO. O In Auto Equiva			
Years	1980	1981	1982	1983
Route 1 Peak Days Demand	8,600	9,400	10,000	11,000
Vancouver 1962	1,536 (8)	768 (4)	Enlarged	2,320 (8)
Saanich 1963	1,536 (8)	1,536 (8)	1,536 (8)	Enlarged
Esquimalt 1963	1,536 (8)	1,536 (8)	1,536 (8)	Enlarged
Victoria 1962	1,536 (8)	1,536 (8)	1,536 (8)	1,536 (8)
Burnaby 1965	Route 2	Route 2	768 (4)	1,536 (8)
Nanaimo 1964	Route 2	Route 2	768 (4)	1,536 (8)
Tsawwassen 1960	1,104 (8)	Idle	Idle	Idle
Alberni 1976	1,160 (8)	1,160 (8)	1,160 (8)	1,160 (8)
New C Class 1981	-	2,880 (8)	2,880 (8)	2,880 (8)
One New C Class '88				
Sub-Total - Route 1	8,404 (48)	9,416 (44)	10,184 (48)	10,968 (48)
Route 2-Peak Days Demand	7,000	7,600	8,100	8,600
Coquitlam 1976	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)
Cowichan 1976	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)
Burnaby 1965	768 (4)	768 (4)	Idle	Route 1
Nanaimo 1964	1,152 (6)	1,152 (6)	Route 1	Route 1
New C Class 1982	-	-	2,880 (8)	2,880 (8)
Sub-Total - Route 2	7,680 (26)	7,680 (26)	8,640 (24)	8,640 (24)
Total Routes 1 & 2				
Total Peak Days Demand	15,600	17,000	18,100	19,600
Total Available Capacity	16,088	17,096	18,824	19,608

Garth Edge - July 1, 1980

RY CORPORATION

Table 3.2

et Expansion Programme

NO. OF SAILINGS PER DAY (in parenthis)

quivalent Spaces

	1984	1985	1986	1987	1988
	11,800	12,700	13,700	15,700	17,380
)	2,320 (8)	1,740 (6)	1,740 (6)	2,320 (8)	2,320 (8)
	2,320 (8)	2,320 (8)	1,740 (6)	2,320 (8)	2,320 (8)
	2,320 (8)	2,320 (8)	2,320 (8)	2,320 (8)	2,320 (8)
)	Enlarged	2,320 (8)	2,320 (8)	2,320 (8)	2,320 (8)
)	Enlarged	Route 2	2,320 (8)	2,320 (8)	2,320 (8)
)	Route 2	Enlarged	2,320 (8)	2,320 (8)	2,320 (8)
	1,104 (8)	Idle	Idle	Idle	
)	1,160 (8)	1,160 (8)	1,160 (8)	1,160 (8)	1,160 (8)
)	2,880 (8)	2,880 (8)	Route 2	Route 2	Route 2
					2,880 (8)
3)	12,104 (48)	12,740 (46)	13,920 (52)	15,080 (56)	17,960 (64)
	9,700	10,300	11,200	11,520	11,520
)	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)
)	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)
	Enlarged	2,320 (8)	New C Class	Ex Route 1	
	1,152 (6)	Enlarged	2,880 (8)	2,880 (8)	2,880 (8)
)	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)	2,880 (8)
6)	9,792 (30)	10,960 (32)	11,520 (32)	11,520 (32)	11,520 (32)
	21,500	23,000	24,900	26,900	28,900
	21,986	23,700	25,440	26,600	29,480

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Table 3.3

CASE 1 - FLEET EXPANSION PROGRAM

YEAR	TRAFFIC IN AUTO.EQUIV. SPACES IN MILLIONS	PEAK DAYS DEMAND IN AUTO. EQUIV. SPACES	NO. OF SHIPS TYPES ALBERNI STRETCHED	ALBERNI TYPE	RAISED "C"	ADDITIONAL SHIPS ALBERNI TYPE	C CLASS TYPE	TO GIVE DAILY CAPACITY OF IN AUTO. EQUIV.SPACES
1980	3.2	15,600	6	2*	2			16,088
1981	3.5	17,000	6	1	3		1	17,096
1982	3.7	18,100	5	1	4		1	18,824
1983	4.0	19,600	4	1	4			19,608
1984	4.4	21,500	4	1	1 4			21,986
1985	4.7	23,000	1	2*	3 4			23,700
1986	5.1	24,900	Ø	1	5 4			25,440
1987	5.5	26,900		1	6 4			27,760
1988	5.9	28,900		2	6 5		1	30,640
89	6.4	31,300		2	6 6		1	33,520
1990	6.9	33,700		2	6 6		Ø	33,520
1991	7.3	35,700		2	6 7		1	36,400
1992	7.8	38,100		2	6 8		1	39,280
1993	8.2	40,100		2	6 9		1	42,160
1994	8.7	42,500		2	6 10		1	45,040
1995	9.2	45,000		2	5 11		1	45,600
1996	9.8	47,900		2	3 14		3	49,600
1997	10.4	50,900		2	1 16		2	50,720
1998	11.0	53,800		2	Ø 17		1	53,600
1999	11.7	57,200		2	19		2	59,360
00	12.4	61,000		2	20		1	62,240
2001	12.9	63,000		2	21		1	65,120
2002	13.4	66,000		2	22		1	68,000
2003	13.9	68,000		2	22		Ø	68,000
2004	14.5	71,000		2	24		2	73,760
2005	15.0	73,000		2	24		Ø	73,760
2006	15.6	78,000		2	26		2	79,520
2007	16.3	80,000		2	27		1	82,400
2008	16.9	83,000		2	28		1	85,280
2009	17.6	88,000		2	29		1	88,160
2010	18.3	89,000		2	30		1	91,040
2011	18.7	91,000		2	30		Ø	91,040
2012	19.0	83,000		2	31		1	93,920
2013	19.4	95,000		2	32		1	96,800
2014	19.8	97,000		2	33		1	99,680
2015	20.2	99,000		2	33		Ø	99,680

*includes MV "Queen of Tsawwassen".

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Table 3.3.1

CASE 1 - CAPITAL INVESTMENT SCHEDULE - SHIPS/TERMINALS/APPROACHES

YEAR	NEW SHIPS IN SERVICE	CAPITAL OUTLAY @ $30 MILLION* EACH SHIP IN MILLION $	TERMINAL COSTS IN MILLION $	COST OF TERMINAL APPROACHES IN MILLION $	SALVAGE VALUE SALE OF SHIPS IN MILLION $	NET CAPITAL INVESTMENT IN MILLION $
1980		30				30
1981	1	15				15
1982	1	0				0
1983	0	0				0
1984	0	0	New Mainland			0
1985	0	15	Terminal			15
1986	0	30	50	10		90
1987	1	30	50	15		95
1988	1	15				15
1989	1	15	New Vancouver Island			15
1990	0	30	Terminal			30
1991	1	30	50	10		90
1992	1	30	50	15		95
1993	1	30				30
1994	1	60				60
1995	1	75			(1)	74
1996	3	45	Two New Terminals		(2)	43
1997	2	45	100	20	(2)	163
1998	1	45	100	30	(1)	174
1990	2	30				30
2000	1	30				30
2001	1	15				15
2002	1	30				30
2003	0	30	Two New			30
2004	2	30	Terminals			30
2005	0	45	100	20		165
2006	2	30	100	30		160
2007	1	30				30
2008	1	30				30
2009	1	15				15
2010	1	15				15
2011	0	30				30
2012	1	30				30
2013	1	15				15
2014	1	0				0
2015	0	0				0
	32	$945	$600	$150	(6)	$1689

*The capital outlay is based upon payment for the building of a ship in 2 equal annual payments in the 2 years preceding its entry into service.

B.C. FERRY CORPORATION

(S 13 - FLEET EXPANSION PROGRAM)

Table 3.4

YEAR	TRAFFIC IN AUTO. EQUIV. SPACES IN MILLIONS	PEAK DAY'S DEMAND IN AUTO. EQUIV. SPACES	NO. OF SHIPS TYPES STRETCHED	ALBERNI TYPE	RAISED	"C"	ADDITIONAL SHIPS ALBERNI TYPE	C CLASS TYPE	TO GIVE DAILY CAPACITY OF IN AUTO. EQUIV.SPACES
1980	3.2	15,600	6	2*		2			16,088
1981	3.5	17,000	6	1		3		1	17,096
1982	3.7	18,100	5	1		4		1	18,824
1983	4.0	19,600	4	1	1	4			19,608
1984	4.4	21,500	4	2*	3	4			21,986
1985	4.7	23,000	1	1	5	4			23,700
1986	5.1	24,900	Ø	1	6	4			25,440
1987	5.5	26,900		2	6	4	1	Ø	27,760
1988	5.9	28,900		2	6	5		1	30,640
1989	6.4	31,300		2	6	6		1	33,520
1990	6.9	33,700		2	6	6		Ø	33,520
1991	7.3	35,700		2	6	7		1	36,400
1992	7.6	37,200		2	6	8		1	39,280
1993	7.9	38,600		2	6	8		Ø	39,280
1994	8.2	40,100		2	6	9		1	42,160
1995	8.5	41,600		2	5	10		1	42,720
1996	8.8	43,000		2	3	12		2	43,840
1997	9.1	45,500		2	1	14		2	44,960
1998	9.4	46,000		2	Ø	16		2	48,400
1999	9.7	47,400		2		16		Ø	48,400
2000	10.0	48,900		2		17		1	51,280
2001	10.3	50,400		2		17		Ø	51,280
2002	10.6	51,800		2		18		1	54,160
2003	10.9	53,300		2		18		Ø	54,160
2004	11.2	54,800		2		19		1	57,040
2005	11.5	56,200		2		19		Ø	57,040
2006	11.8	57,700		2		20		1	59,920
2007	12.1	59,200		2		20		Ø	59,920
2008	12.4	60,600		2		21		1	62,800
2009	12.7	62,100		2		21		Ø	62,800
2010	13.0	63,600		2		22		1	65,680
2011	13.3	65,000		2		22		Ø	65,680
2012	13.6	66,500		2		23		1	68,560
2013	13.9	68,000		2		23		Ø	68,560
2014	14.2	69,400		2		24		1	71,440
2015	14.5	70,900		2		24		Ø	71,440

* includes MV "Queen of Tsawwassen".

B.C. FERRY CORPORATION

Table 3.4.1 43.

CASE 13 - CAPITAL INVESTMENT SCHEDULE SHIPS/TERMINALS/APPROACHES

YEAR	NEW SHIPS IN SERVICE	CAPITAL OUTLAY AT $30 MILLION EACH SHIP* IN MILLION $	TERMINAL COSTS IN MILLION $	ACCESS TO TERMINALS IN MILLION $	SALVAGE VALUE SALE OF SHIPS IN MILLION $	NET CAPITAL INVESTMENT IN MILLION $
1980		30				30 + 6*
1981	1	15				15 + 65***
1982	1	Ø				Ø + 10**
1983	Ø	Ø				Ø + 20**
1984	Ø	Ø	New Mainland			Ø + 20**
1985	Ø	15	Terminal			15 + 10**
1986	Ø	30	50	10		90
1987	1	30	50	15		95
1988	1	15				15
1989	1	15				15
1990	Ø	30				30
1991	1	15	New Vancouver Island Terminal			15
1992	1	15	50	10		75
1993	Ø	30	50	15		95
1994	1	45				45
1995	1	60			(1)	59
1996	2	60			(2)	58
1997	2	30			(2)	28
1998	2	15			(1)	14
1999	Ø	15				15
2000	1	15				15
2001	Ø	15				15
2002	1	15				15
2003	Ø	15				15
2004	1	15				15
2005	Ø	15				15
2006	1	15				15
2007	Ø	15				15
2008	1	15				15
2009	Ø	15	Two New Terminals			15
2010	1	15	100	20		135
2011	Ø	15	100	30		145
2012	1	15				15
2013	Ø	15				15
2014	1	15				15
2015	Ø	15				15
	23	705	$400	100	(6)	1199 + 131

*The Capital Outlay is based upon payment for the building of a ship in 2 equal annual payments in the 2 years preceding its entry into service.

* $6 million in 1980 for terminal work at Departure Bay.

** $60 million in 1982/85 for adding deck to 6 'stretched' ships.

*** $65 million in 1981 for alterations to Tsawwassen and Swartz Bay to handle "raised" ships.

CHAPTER FOUR

A FINANCIAL APPRAISAL

OF FERRY SERVICES

BETWEEN THE LOWER MAINLAND AND VANCOUVER ISLAND

CHAPTER 4

A Financial Appraisal Of Ferry Services Between the Lower Mainland and Vancouver Island

1. Introduction

1.1 The purpose of examining the financial situation of the Corporation is:-

(i) to abstract that part of its service relating primarily to the existing ferry routes across the Strait of Georgia - Tsawwassen/ Swartz Bay (Route 1) and Horseshoe Bay/Nanaimo (Route 2).

(ii) to determine whether these services are financially viable such that the revenues are sufficient to cover their operating expenses including depreciation, based upon an agreed fare structure.

(iii) to review the adequacy of the fare structure.

(iv) to determine the rate of return on the capital investments in these routes.

1.2 Precision in such a purposeful financial review would require a detailed accounting analysis absorbing some considerable time. An approximation can however be quickly achieved which will still provide answers of sufficient depth such that the financial viability of ferry services can be evaluated against the economics of a Fixed-Link in place of ferry services.

2. Financial Statements

2.1 The following Table records the financial performance for the ferry system as a whole for the last three years.

Table 2.1

	1978	1979	1980
Operating Revenues			
Tolls	$47,913,905	$54,274,342	$60,377,636
Catering	11,937,809	14,226,456	17,933,492
Other	569,532	1,136,886	1,101,528
	$60,411,246	$69,637,684	$79,412,656
Less: Cost of food, etc.♦	5,008,622	6,439,904	7,839,503
	$55,402,624	$63,197,780	$71,573,153
Operating Costs			
Salaries	$47,611,460	$50,690,403	$56,207,472
Dep'n/Amortization	18,778,144	19,354,248	20,270,582
Fuel/Lubricants	8,628,540	10,057,983	12,103,783
Supplies/Services	5,461,611	6,314,432	7,582,908
Repairs/Maintenance	10,887,848	8,132,286	7,355,505
Marketing/Admin.	4,129,613	4,009,284	3,449,166
Charter Fees	1,090,985	1,728,403	1,996,453
	$96,588,201	$100,287,039	$108,965,869
Operating Profit (Loss)	($41,185,577)	($ 37,089,259)	($ 37,392,716)
(Loss) Gain on Capital Account	($ 701,987)	($ 166,201)	$ 3,454,724
Total (Loss) before subsidy	($41,887,564)	($ 37,255,460)	($ 33,937,992)
Highway Equivalent Subsidy	$43,558,700	$ 46,564,250	$ 49,447,325
Net Profit (Loss)	$ 1,671,136	$ 9,308,790	$ 15,509,333

2,573,123 9,474,911 12,054,604

♦ Costs of food are excluded from operating costs shown below but wages related to catering services are included under salaries as part of operating costs.

2.2 A financial forecast by routes for the twelve months ending 31 March 1980 is given in the following Table:-

Table 2.2

Routes 1 & 2	1979/80 Financial Year	
Operating Revenues	$ 61,412,656	(77% of Total Revenues)
Operating Costs (excl. dep'n)	58,307,013	(60% of Total Op'g Costs)
Gain (Loss)	$ 3,105,643	
All Other Routes		
Operating Revenues	$ 18,000,000	(13% of Total Revenues)
Operating Costs (excl. dep'n)	38,227,777	(40% of Total Op'g Costs)
Gain (Loss)	($ 20,227,777)	
Depreciation		
Routes 1 & 2	$ 11,412,000	(56%)
All Other Routes	8,858,582	(44%)
Total	$ 20,270,582	(100%)
Capital Account Earnings		
Routes 1 & 2	$ 2,418,306	(70%)
All Other Routes	1,036,418	(30%)
Total	$ 3,454,724	(100%)

Notes: (1) The allocations of revenues and costs, including depreciation between Routes 1 & 2, and All Other Routes are based on the actual figures recorded in the first 11 months of the year using the actual percentage figures.

(2) Capital Account earnings are primarily the interest earned on funds in bank and short-term investments. These have been allocated to Routes 1 and 2 using an approximate average of the "Revenue" and "Cost" percentages for Routes 1 and 2 of 77% and 60% respectively.

2.3 A summary of the above Tables for the 12 months ending March 31, 1980 is given below:

Table 2.3

	OPERATING SURPLUS (LOSSES) $	DEPRECIATION (COST) $	CAPITAL ACCOUNT SURPLUS $	TOTAL PROFIT (LOSS)* $
Routes 1 & 2	3,105,643	(11,412,000)	2,418,306	(5,888,051
All Other Routes	(20,227,777)	(8,858,582)	1,036,418	(28,049,941)
TOTAL	(17,122,134)	(20,270,582)	3,454,724	(33,937,992)

* The 1979/80 loss of $33,937,992 is recorded before the Province of B.C. Highway Equivalent Subsidy of $49,447,325 is applied. After provision is made for this, the TOTAL NET PROFIT for the 12 months is $15,509,333.

3. The Province of B.C. Highway Equivalent Subsidy

3.1 As a matter of factual record, the amount of the subsidy received by the Corporation from the Province of B.C. is substantially equivalent to the aggregate of the annual cost of maintaining, and the annual amortisation of the capital cost of a two-lane highway built through difficult terrain in the coastal region related to the length of the total ferry routes operated by the Corporation.

6.87447.2 %

3.2 The amount of the subsidy which was generated by Routes 1 and 2 in 1979/80 was $3,399,361 out of the total subsidy of $49,447,325. In terms of mileage, Routes 1 and 2 together account for only 100 kms. in the total ferry system of 1780 kms.

3.3 It is apparent therefore, that in the event that Routes 1 and 2 were discontinued, the total subsidy paid to the Corporation would be reduced by very little, given the continuance of the current formula for determining the annual subsidy.

4. Financial Viability of Routes 1 & 2

4.1 The performance of Routes 1 & 2 are again summarized below:

Table 4.1

	1979/80
Total Revenues	$61,412,656
Total Operating Costs (excl. dep'n)	58,307,013
Operating Surplus	$ 3,105,643
Less Depreciation	11,412,000
Plus Capital Account Allocation	2,418,306
Total Profit/(Loss)	($ 5,888,051)

4.2 The loss shown of $5,888,051 after depreciation represents 9.6% of the total revenue on Routes 1 and 2 in 1979/80. If the revenues had been 9.6% higher than shown, both routes taken as a whole would have broken even.

4.3 If the vehicle fare had been $1.00 higher in 1979/80 (ie. $10) and if the average passenger fare had been higher by $0.40, this would have yielded additional revenue of:-

2,914,441 auto. equiv. spaces x $1.00	=	$2,900,000
7,400,000 fare-paying passengers x $0.40	=	2,960,000
		$5,860,000

Such fare increases as indicated would have wiped out the loss of $5,888.000 indicated above in Table 4.1.

4.4 It can be concluded that given the recent fare increase on vehicular traffic (effective in June 1980) and given an increase in passenger fares, both Routes 1 and 2 can become self-sustaining, subject only to resolving some doubts about capital charges and levels of depreciation relating to the current values of existing ships and terminals, and also to the financing of the Corporation's planned investments in the future for these two routes.

4.5 The financial viability of these routes will be examined in the paragraphs below by relating a derived net income (revenues minus costs) to the capital investments now in the system and as planned, and calculating a discounted rate of return.

5. Capital Investments Pertaining to Routes 1 & 2

5.1 The present value of the ships now in service on Routes 1 and 2 are given below. These are the current values used for insurance purposes:-

Ships

Queen of Alberni built 1976	$ 24,000,000
Queen of Cowichan built 1976	29,000,000
Queen of Coquitlam built 1976	29,000,000
Queen of Vancouver built 1962	22,000,000
Queen of Saanich built 1963	22,000,000
Queen of Esquimalt built 1963	22,000,000
Queen of Victoria built 1962	22,000,000
Queen of Burnaby built 1965	22,000,000
Queen of Nanaimo built 1964	22,000,000
Queen of Tsawwassen built 1960	16,000,000
TOTAL VALUE OF SHIPS	$230,000,000

5.2 Berths, Buildings, Contents and Equipment at Terminals

Tsawwassen - Total Value	$18,585,000	- 90% of which is	$16,700,000*
Swartz Bay - Total Value	11,821,000	- 90% of which is	10,600,000*
Departure Bay - Total Value	5,847,000	- 100% of which is	5,800,000*
Horseshoe Bay - Total Value	9,486,000	- 90% of which is	8,500,000*
Head Office - Total Value	552,000	- 60% of which is	300,000*
			$41,900,000

* These represent an arbitrary allocation of the total investment value at each terminal to Routes 1 and 2.

5.3 The total value of investments now in service on Routes 1 and 2 is therefore $272,000,000.

5.4 A schedule of the needed new investments in ships and terminals over the years 1980-2015 is shown in Table 6.1.

6. Net Revenues Pertaining to Routes 1 & 2

6.1 Forecasting problems are encountered in determining net revenues. A stream of forecast annual gross revenues can be easily calculated based upon a given fare structure in 1980 prices and the traffic projections. However, this stream of gross revenues must be matched by a stream of estimated annual operating costs related to the type of services to be provided using different classes and sizes of ships. It would be a lengthy process to analyse and forecast a detailed composition of these costs; and in the end result, the forecasts would be very arbitrary.

It is therefore, intended to use the actual figures of net income per auto equiv. space using the forecast traffic figures. It will however also be necessary to make some arbitrary adjustments to recognize the reduction in operating costs that will result from bringing into service the "lifted" stretched vessels with their enlarged carrying capacity.

6.2 The net revenue calculations are presented below:-

1979/80		
Operating Surplus	$3,105,643	(Table 4.1)
Plus Capital Account Allocation	2,418,306	(Table 4.1)
	$5,523,949	

Additional Revenue assuming higher fares:-

Vehicles - $1.00 x 2,912,441 A.E.S.	$2,914,441
Passengers - $0.40 x 7,400,000 passengers	2,960,000
	$11,398,390

6.3 Insofar as the Capital Account Allocation will soon disappear because the investment funds which are now earning interest will have to be used for capital acquisitions by the Corporation (new ships), it is considered necessary to recommend a further fare increase in real terms of $1.00 per vehicle and $0.30 per passenger, representing a 10% fare increase. The demand is believed to be such that an increase in price will not reduce the traffic. The further increase of revenue resulting from this fare increase using 1979/80 figures would be:-

Vehicles - $1.00 x 2,912,000 A.E.S.	$2,914,000
Passenger - $0.30 x 7,400,000 passengers	2,960,000
	$5,874,000

6.4 The final effect of these fare increases and the deletion of the Capital Account Allocation would be as follows:

1979/80	Total Revenues	$61,412,656	(Table 4.1)
	+ Higher Fares (para. 6.2)	5,874,441	
	+ Higher Fares (para. 6.3)	5,134,441	
		$72,421,538	

After deducting operating costs of $58,307,013 (Table 4.1) the net revenue would be $14,114,525.

The average net revenue per automotive equivalent space (using the 79/80 total of 2,914,441 A.E.S.) is therefore $4.84 per A.E.S.

It will therefore be appropriate to use an average net revenue per auto equivalent space of $4.80 for 1981 through 1984 by which time most of the present "stretched" vessels will have been raised and the capacity increased. It is assumed that the operation of these enlarged vessels would have the effect of reducing real operating costs by 5%, thereby increasing the net revenue to $5.80 per A.E.S. This figure is derived from the following calculation, still in 1979/80 terms:-

Total Revenues	$72,000,000		(para 6.4 above)
Less Operating Costs 95% x $58,000,000	55,000,000		
Net Revenue	$17,000,000		
Net Revenue per A.E.S.	$ 5.83	say	$5.80

An average net revenue of $5.80 can then be applied to the forecast vehicle traffic for the years 1985 on.

A special case is calculated for 1980 since the only fare increase is for vehicles effective June 1980, and part of the increased revenue that will accrue will have to be charged off to higher operating costs - estimated at about 7% higher in 1980/81 than in 1979/80 reflecting inflationary factors (not growth factors).

The calculation for 1980 will therefore be:-

1979/80	Total Revenues on 2,914,000 A.E.S.	$61,412,656 (Table 4.1)
	Plus Higher Fares on Vehicles for 10 months	
	i.e. 10/12 x 2,914,000 x $1.00	2,428,000
		$63,840,656
	Less 107% of $58,000,000	62,060,000
		$ 1,780,656
	Plus Capital Acct. Allocation	2,418,306
		$ 4,198,962

This corresponds to an average net revenue of $1.44 per auto equivalent space related to the 79/80 traffic volume of A.E.S. (rounded out to $1.45).

The average net revenues so derived per A.E.S. take into account the numbers of passengers since the ratio of passengers to vehicles has been and is assumed to remain fairly constant.

On the basis of these derived average net revenues, it is possible to provide projections of the annual net revenues (before depreciation) accruing from the ferry crossings between Vancouver Island and the Lower Mainland and relate these to the capital investments in the ferry system on these routes. These projections are contained in Table 6.1.

It is to be emphasized that these are dependent upon real fare increases being implemented in 1981 over and above those dictated by purely inflationary pressures. The extent of these fare increases may be lessened by the extent to which the Province of B.C. subsidises the operations of these routes. In all the calculations subsidy payments have been disregarded.

7. Summary Findings:

7.1 Fares

In order to make Routes 1 and 2 completely self-supporting in terms of both operating costs and capital requirements, it has been calculated that the real fare structure in terms of 1979/80 costs should be as follows:

Vehicles - $11.00 each with corresponding fares for commercial vehicles, etc.

Passengers - An increase of $0.70 in the average passenger fare currently calculated to be $2.60, bringing the new fare to an average of $3.30 per fare-paying passenger.

It should be noted that fares will also require to be raised to absorb inflationary increases in operating costs.

7.2 Net Revenues

The above fares will yield annual net revenues (before depreciation) as listed in Table 6.1. These are based on the Case 13 Traffic Forecasts and on operating costs that are expected to decline on a per vehicle basis as a result of adding a deck to the existing "stretched" vessels which will increase their carrying capacity per crossing. It is assumed that the net revenues will be closely monitored to ensure that in real terms they remain similar to the forecasts shown herein by adjusting the fares as required.

7.3 New Capital Requirements

The estimated new capital requirements for additional ships, adding decks to the "stretched" vessels, terminal alterations and terminal additions are shown in Table 6.1. A summary of these capital requirements is given below in Table 7.1.

Table 7.1

	Forecast New Capital Investments
1980-1984	$166,000,000
1985-1989	240,000,000
1990-1994	260,000,000
1995-1999	174,000,000
2000-2015	490,000,000
	$1,330,000,000

7.4 The value of the present capital investment in ships and terminals pertaining to Routes 1 and 2 is $272,000,000.

8. Rates of Return

8.1 The comparative stream of annual net revenues and new investment capital for the years 1980 through 2015 is shown in Tables 6.1.1 and 6.1.2. On a present-worth-basis these two streams of revenues and capital expenditure reflect an annual rate of return of about 5%.

This figure only has significance with respect to comparing the economics of a ferry system with that of a fixed-link crossing insofar as new additional capital is needed for both means of linking the Lower Mainland with Vancouver Island. If the comparative stream of net revenues accruing from a fixed-link can be shown to yield a discounted rate of return on its capital costs that exceed that shown for the ferry system, then a fixed-link crossing could be preferred over the continuation of the ferry system provided of course, that other non-economic considerations are also favourable.

8.2 The profitability of ferry operations in terms of a discounted rate of return cannot be adduced from the above calculation. This can only be adjudged if one includes the value of the present capital investment already sunk in the ferry system in the overall stream of Route 1 and 2 investment costs. If one does this, even without undertaking the detailed calculations, it is apparent that at the proposed fare levels, routes 1 and 2 would be doing no better than just breaking-even, with the possibility of a slight loss. The value of the present capital investment in ships and terminals of $272 million when introduced into the investment stream in the first year of the assessment period - 1980 through 2015 - represents a large undiscounted investment value. However, it should be noted that if one values the ships and terminals at their possible resale value, their value in alternative uses would be considerably less since buyers would be difficult to find.

8.3 It should be noted that if the traffic growth volumes are less than projected, the investment capital required for new ships and terminals can be reduced or delayed accordingly. The scenario of investments in the ferry system also reflects an overstatement of its requirements since it is now believed that the vehicle capacity of a "raised" vessel would be about 400 and not 290 as originally thought and used in the detailed growth model for the ferry corporation.

Garth A. Edge
July 9, 1980

Table 6.1

B.C. FERRY CORPORATION
PROJECTED NET REVENUES AND INVESTMENTS
Routes 1 & 2 and Additional Crossings

YEAR	CASE 13 TRAFFIC AUTO. EQUIV. SPACES IN MILLIONS	NET REVENUE PER A.E.S. $	ANNUAL NET REVENUES BEFORE DEPRECIATION IN MILLIONS	FORECAST NEW CAPITAL INVESTMENTS IN MILLIONS
1979	2.9	1.90	$ 5.5	
1980	3.2	1.45	4.6	36 (1) (2)
1981	3.5	4.80	16.8	80 (2) (4)
1982	3.7	4.80	17.8	10 (3)
1983	4.0	4.80	19.2	20 (3)
1984	4.4	4.80	21.0	20 (3)
1985	4.7	5.80	27.0	25 (3)
1986	5.1	"	30.0	90
1987	5.5	"	32.0	95
1988	5.9	"	34.0	15
1989	6.4	"	37.0	15
1990	6.9	"	40.0	30
1991	7.3	"	42.0	15
1992	7.6	"	44.0	75
1993	7.9	"	46.0	95
1994	8.2	"	48.0	45
1995	8.5	"	49.0	59
1996	8.8	"	51.0	58
1997	9.1	"	53.0	28
1998	9.4	"	55.0	14
1999	9.7	"	56.0	15
2000	10.0	"	58.0	15
2001	10.3	"	60.0	15
2002	10.6	"	61.0	15
2003	10.9	"	63.0	15
2004	11.2	"	65.0	15
2005	11.5	"	67.0	15
2006	11.8	"	68.0	15
2007	12.1	"	70.0	15
2008	12.4	"	72.0	15
2009	12.7	"	74.0	15
2010	13.0	"	75.0	135
2011	13.3	"	77.0	145
2012	13.6	"	79.0	15
2013	13.9	"	81.0	15
2014	14.2	"	82.0	15
2015	14.5	"	84.0	15

(1) includes $6 million for Departure Bay Terminal.
(2) represents $45 million towards payment for 2 C Class ships now been built.
(3) includes $60 million for adding decks to 6 'stretched' ships.
(4) includes $65 million for alterations to Tsawwassen & Swartz Bay to handle 'raised' ships.

B.C. FERRY CORPORATION

Table 8.1

PRESENT WORTH CALCULATIONS OF NET REVENUES & NEW INVESTMENTS

YEAR	ANNUAL NET REVENUES $ IN MILLIONS	FORECAST NEW CAPITAL INVESTMENTS IN MILLIONS	PRESENT WORTH @ 10% REVENUES	PRESENT WORTH @ 10% INVESTMENTS	PRESENT WORTH @ 6% REVENUES	PRESENT WORTH @ 6% INVESTMENTS
1980	4.6	36	4.17	32.66	4.34	33.93
1981	16.8	80	13.82	65.82	14.93	71.07
1982	17.8	10	13.28	7.46	14.91	8.38
1983	19.2	20	12.99	13.54	15.16	15.79
1984	21.0	20	12.89	12.28	15.62	14.88
1985	27	25	15.03	13.92	18.94	17.54
1986	30	90	15.15	45.46	19.83	59.50
1987	32	95	14.66	43.52	19.94	59.19
1988	34	15	14.13	6.23	19.98	8.81
1989	37	15	13.94	5.65	20.49	8.30
1990	40	30	13.67	10.25	20.88	15.66
1991	42	15	13.02	4.65	20.66	7.38
1992	44	75	12.37	21.09	20.40	34.78
1993	46	95	11.73	24.23	20.11	41.52
1994	48	45	11.10	10.41	19.78	18.54
1995	49	59	10.29	12.38	19.03	22.91
1996	51	58	9.71	11.04	18.67	21.23
1997	53	28	9.15	4.84	18.29	9.66
1998	55	14	8.61	2.19	17.89	4.55
1999	56	15	7.95	2.13	17.17	4.60
2000	58	15	7.47	1.93	16.76	4.34
2001	60	15	7.01	1.75	16.34	4.09
2002	61	15	6.47	1.59	15.66	3.85
2003	63	15	6.05	1.44	15.25	3.63
2004	65	15	5.67	1.31	14.82	3.42
2005	67	15	5.29	1.19	14.41	3.23
2006	68	15	4.88	1.08	13.78	3.04
2007	70	15	4.55	0.98	13.37	2.87
2008	72	15	4.25	0.89	12.96	2.70
2009	74	15	3.96	0.80	12.56	2.55
2010	75	135	3.65	6.56	12.00	21.60
2011	77	145	3.39	6.38	11.61	21.87
2012	79	15	3.15	0.60	11.23	2.13
2013	81	15	2.93	0.54	10.85	2.01
2014	82	15	2.70	0.49	10.36	1.89
2015	84	15	2.50	0.45	10.00	1.79
			311.58	377.73	568.98	563.23

B.C. FERRY CORPORATION

Table 8.2 * 57.

PRESENT WORTH CALCULATIONS OF NET REVENUES & NEW INVESTMENTS

YEAR	ANNUAL NET REVENUES $ IN MILLIONS	FORECAST NEW CAPITAL $ IN MILLIONS	ANNUAL NET REVENUES $ IN MILLIONS		FORECAST NEW CAPITAL $ IN MILLIONS	PRESENT WORTH @ 5% REVENUES	PRESENT WORTH @ 5% COSTS
1980	4.6	36					
1981	16.8	80			Consolidated		
1982	17.8	10			in 1983 figure		
1983	19.2	20	Yr. 1		146		139
1984	21.0	20	2		20		18
1985	27.0	25	3		25		22
1986	30.0	90	4	30	90	24	74
1987	32.0	95	5	32	95	25	74
1988	34	15	6	34	15	25	11
1989	37	15	7	37	30	26	21
1990	40	30	8	40	15	27	10
1991	42	15	9	42	75	27	48
1992	44	75	10	44	95	27	58
1993	46	95	11	46	45	27	26
1994	48	45	12	48	59	27	33
1995	49	59	13	49	58	26	31
1996	51	58	14	51	28	26	14
1997	53	28	15	53	14	25	7
1998	55	14	16	55	15	25	7
1999	56	15	17	56	15	24	6
2000	58	15	18	58	15	24	6
2001	60	15	19	60	15	23	6
2002	61	15	20	61	15	23	6
2003	63	15	21	63	15	22	5
2004	65	15	22	65	15	22	5
2005	67	15	23	67	15	22	5
2006	68	15	24	68	15	21	5
2007	70	15	25	70	15	20	4
2008	72	15	26	72	15	20	4
2009	74	15	27	74	15	20	4
2010	75	135	28	75	135	19	34
2011	77	145	29	77	145	18	35
2012	79	15	30	79	15	18	3
2013	81	15	31	81	15	18	3
2014	82	15	32	82	15	17	3
2015	84	15	33	84	15	17	3
						685	730

* This Table corresponds to Table 6.1.1 and is amended only by evaluating the present-worth of the revenues and costs as from 1983 in order to correspond to the evaluation of the Fixed-Link building in 1983/85 and in service in 1986.

CHAPTER FIVE

THE ECONOMICS

OF A

FIXED-LINK CROSSING

CHAPTER 5

The Economics of a Fixed-Link Crossing

1. Its Location, Engineering Design and Cost

1.1 The actual recommended siting of a Fixed-Link crossing would have to await a detailed engineering study but it can be assumed that its terminal point on the Lower Mainland would lie between Iona and Roberts Bank, and between Ladysmith and Duncan on Vancouver Island.

1.2 The design of the Fixed-Link crossing would also have to await detailed engineering studies but again it is very unlikely that a tunnel would be selected and therefore the Fixed-Link would probably consist of some form of floating bridge suitable only for vehicular traffic.

1.3 The cost of constructing the Fixed-Link crossing would include the approaches to it on the Mainland, and the cost of whatever route is chosen to take the crossing through the Gulf Islands to Vancouver Island and to connect to Highway No. 1. The pre-feasibility of the economics of establishing a Fixed-Link crossing will initially assume that the final cost in 1980 prices will be $3,000 million. The final cost of building the crossing will exceed this figure because of inflationary factors, but similarly these same factors will also inflate the benefits which are to be given in 1980 prices.

2. Conditions for Operating the Fixed-Link Crossing

2.1 The Fixed-Link will be capable of safely carrying all vehicles of up to the legal G.V.W. limits, with an adequate safety margin.

2.2 It is assumed that it will be open 24 hours daily and that traffic will not be significantly restricted or delayed by weather conditions or the passage of ships.

2.3 It is assumed that the existing ferry service between Horseshoe Bay and Nanaimo will cease entirely once the Fixed-Link is in operation. That value of the Horsehoe Bay terminal presently assigned to the Route 2 ferry crossing will instead be charged up to the economic cost of the Fixed-Link. The Horseshoe Bay terminal will continue in operation to service the ferry corporation's other routes. It would be inequitable to charge all the Horseshoe Bay terminal costs up to these other routes and to the B.C. Ferry Corporation in general. This value is arbitrarily set at 75% of the current worth of the Horseshoe Bay Terminal. (as shown in paragraph 5.2 of Chapter 4)

2.4 It is assumed that the terminals at Tsawwassen and Swartz Bay would also continue in operation to allow the B.C. Ferry Corporation to provide services to the Gulf Islands. In this pre-feasibility assessment of the economics of a Fixed-Link crossing, it will be assumed that all ferry services between Tsawwassen and Swartz Bay will cease. Accordingly, those values of the Tsawwassen and Swartz Bay terminals now charged up to the Route 1 ferry crossing will instead by charged up to the economic cost of the Fixed-Link crossing. These values are also arbitrarily set at 75% of the current worth of the terminals as established in paragraph 5.2 of Chapter 4.

It will also be necessary to charge up as a cost of the Fixed-Link crossing 90% of the cost of making the alterations to Tsawwassen and Swartz Bay terminals to handle "raised" ships since it is presumed that these would come into service before the Fixed-Link was built and in operation. Cost of these new facilities is estimated to be $65 million, 90% of which would be $58.5 million.

In reality it is possible that a ferry service between Tsawwassen and Swartz Bay might be maintained by two ships to service some tourist traffic - say, every 2 hours from each terminal i.e. one shift of 8 hours/day for each ship. For purposes of this analysis, this eventuality is not taken into account. (If such a service is maintained it reduces the economic attractiveness of a Fixed-Link crossing).

2.5 The opening of a Fixed-Link crossing would occasion the disposal of many of the Ferry Corporation's ships at values considerably less than their worth in service. However, their depreciated value on an original cost basis would be relatively low and it is assumed that the disposal prices obtained from the sale of the ships would at least cover these depreciated values on an original cost basis. It is not therefore necessary to charge up a loss on the sale of the ships to the cost of a Fixed-Link crossing. This same argument cannot be applied to the value of the terminals since they are not considered saleable items.

3. Benefits and Costs Arising from the Operation of a Fixed-Link Crossing

3.1 The methodology involved in evaluating the economics of a Fixed-Link is to compare it in terms of revenues and costs with the continued operation of ferry services. These were analysed in detail in the previous chapter in which the investment costs of providing ferry services were shown and these were related to the net revenues derived from a stated fare structure. The discounted internal rate of return on the new capital invested in the ferry system across the Strait of Georgia was thereby calculated.

3.2 Based upon the same fare structure as applicable to a ferry system, a Fixed-Link crossing will be shown to be more economic than a ferry system if the sum of the net revenues earned from tolls and the net beneficial value of the time saved crossing via a Fixed-Link earns a higher discounted internal rate of return on both the new capital invested in the Fixed-Link and the value of the Ferry Corporation's assets rendered worthless by the operation of the Fixed-Link crossing, than that earned

by a continued ferry service.

3.3 The net revenues accruing from the traffic using the Fixed-Link are the gross revenues derived from traffic paying a bridge toll of $11.00 per automobile equivalent space and $3.30 per passenger (in 1980 prices), less the average annual operating costs of the Fixed-Link and less the average annual repair and maintenance costs of the crossing structure. While these costs will be significant they are as yet undetermined but estimated at $20 million annually on average.

3.4 The estimated volume of traffic using the Fixed-Link is the same traffic volume as to be found on a ferry system plus additional traffic. The additional traffic would be the sum of (a) new traffic that would not otherwise have travelled, but is encouraged to do so by the greater convenience and shorter time of being able to drive between the Mainland and the Island without having to wait for the ferry services, and (b) a switch-over of some of the present commercial traffic now carried by the CP ship services. In Chapter 2, paragraph 5.10 it was estimated that the additional traffic newly generated, would be 25% of the traffic as forecase for ferry operations.

3.5 The time-saving that would result from using a Fixed-Link instead of the ferry service was referred to in paragraph 5.8 in Chapter 2 "Traffic Forecasts." It was deduced that on average, one can reasonably anticipate a time-saving per one-way crossing of 1½ hours.

3.6 No amount of convoluted examination, interpretation, evaluation, analysis or what-have-you is going to be able to translate this hourly time-saving per crossing into a reliable economic usable dollar value. One may however presume that it has a positive value since it is not necessary to give a negative dollar value to the loss of satisfaction to people who would prefer to spend a longer time travelling on a ferry. One can be sure that there will be definite dollar savings accruing to some business people who value their time highly. There will also be a saving in hotel expenses to people who will be able to travel more easily without having to spend a night either on the Mainland or

on Vancouver Island. (but even this latter aspect is questionable since the dollars saved by the person not having to stay overnight in a hotel/restaurant etc. is money lost by those providing such services) There will also be some saving in a commercial/industrial context in that goods can be moved more quickly; trucks can be more efficiently utilised. However enough has been written, to indicate that nothing short of an exhaustive examination over time of the people travelling will reveal their travel objectives, motives and feelings to that some validity can be ascribed in dollar terms to the time saved. The most that can be asserted is that the value of the time saved is some arbitrary positive number. The danger is that the arbitrary number can be chosen such as either to justify or to invalidate the concept of Fixed-Link crossing. It is therefore intended to not ascribe any value to the time-savings in the analysis. Consideration of this factor can be subjectively made after the economic anlysis has been completed.

3.7 A measurable economic impact resulting from having a Fixed-Link crossing does arise in the case of the consumption of gasoline and diesel fuel in the cars and trucks using the Fixed-Link. This is evaluated in simple terms as follows:-

One vehicle with a gasoline fuel consumption of 11.36 litres per 100 km (25mpg) having to drive an <u>additional</u> 40 km per Fixed-Link crossing will consume an <u>additional</u> 4,546 litres valued at $0.176 per litre net of taxes (Provincial Tax of $0.037 per litre; Federal Tax of $0.02 per litre; Excise Tax of $0.02 per litre). This is equivalent to $0.80 per crossing. The added cost to a vehicle using diesel fuel would be somewhat less. This energy component is a cost factor that could be legitimately increased over time since the real cost of fuel will rise as Canadian oil values are progressively raised to world price levels. Nevertheless in this study, this added cost will be recognised simplistically using the above cost factor only and applying it to the number of vehicles (not automobile equivalent spaces) using the Fixed-Link crossing.

Offsetting this added cost, will be the savings in the fuel

costs by not operating the ferries. However since these costs are already included in the evaluation of the ferry system and the calculation of the discounted rate of return applicable to the ferry services, it must be excluded from the evaluation of the Fixed-Link crossing.

3.8 Consideration must also be given to the regional economic impact of the proposed Fixed-Link crossing to determine whether the impact is economically measurable. In a preliminary report presented by the Ministry of Industry and Small Business Development (June 1980) copy attached, there is nothing contained therein to indicate that a Fixed-Link crossing, without any toll, would exert any net appreciable influence on the regional economies of the Lower Mainland or Vancouver Island. With a toll, what influences there might be with a toll-free crossing, would tend to disappear entirely. In the lack of any positive and measurable impact, this factor will be assumed to be neutral.

3.9 It can be presumed that in general terms the environmental effects would be detrimental insofar as any development is generally regarded nowadays to produce some harmful effects on the environment. However the "harmful" effects of a Fixed-Link crossing will have to be evaluated against the "haraful" effects of instituting a third, fourth or even fifth ferry crossing route across the Strait of Georgia, each one passing through the Gulf Islands by one means or another, and each one requiring terminals and approaches on both the Lower Mainland and Vancouver Island. The environmental effects will therefore require very careful evaluation when it is known what type and where such a crossing would be built.

3.10 The effects upon maritime shipping using the Strait of Georgia is also difficult to foretell until the type and location of the Fixed-Link crossing is known. It must also be noted that maritime shipping can itself exert an influence upon the operation of the Fixed-Link. More particularly one will have

to assess the dangers inherent in the possibility of the collision of ships with the Fixed-Link. The Vessel Traffic Management Centre of the Canadian Coast Guard operating out of its West Vancouver Terminal is very well equipped to control all shipping movements in the Strait of Georgia and they can provide under reasonable conditions, adequate support for the navigation of ships through openings on the bridge-link. Statistical information on this topic is given in Appendix A but a detailed appraisal of the problems will have to originate from the technical feasibility studies. Suffice to comment in this context that there may be a problem in this respect which would not be a benefit to either shipping movements in the Strait or to the Fixed-Link crossing.

4. An Evaluation of the Economics of Constructing a Fixed-Link

4.1 The economics of appraising the construction of the Fixed-Link crossing is based upon the following:-

(i) The Case 13 traffic forecast for ferry operations plus a 25% increase in traffic resulting from the availability of a Fixed-Link.

(ii) A crossing toll of $11.00 for vehicles and $3.40 for passengers in constant 1980 prices.

(iii) Annual operating and maintenance costs of about $20 million per annum.

(iv) Increased total fuel consumption by vehicles using the Fixed-Link.

(v) A zero value given to the time-savings.

(vi) A zero value given to the economic impact.

(vii) Zero values given to environmental considerations and maritime shipping movements.

(viii) An estimated cost of constructing the Fixed-Link of $3,000 million.

(ix) An appraisal period of thirty years commencing in 1986 following three years of construction.

4.2 On the above basis the net present worth of the Fixed-Link crossing is indicated from the following results - as indicated in Tables 4.1 and 4.1.1.

Net Present worth @10% Discount Rate - Minus $1,368 million
@ 5% Discount Rate - Minus $ 290 million

The discounted internal rate of return on the investment would be approximately 3.5%; that is, below the indicated rate of return for new investments in ferry services.

"FIXED LINK"

Table 4.1

TRAFFIC ESTIMATES & REVENUES

	AUTO EQUIVALENT SPACES			PASSENGERS		ANNUAL REVENUES	
	CASE 13 FERRY TRAFFIC in Millions	CASE 13 + 25% in Millions	CASE 13 FERRY TRAFFIC in Millions	CASE 13 + 25% @ 2.5 PASSENGERS PER A.E.S.	A.E.S. @$11.00 EACH	PASSENGERS @ $3.40 EACH $ Millions	TOTAL $ Millions
1980	3.2		8.2				
1981	3.5		8.9				
1982	3.7		9.4				
1983	4.0		10.2				
1984	4.4		11.2				
1985	4.7		12.0				
1986	5.1	6.4	13.0	16.0	70.4	54.4	124.8
1986	5.5	6.9	14.0	17.2	75.9	58.5	134.4
1988	5.9	7.4	15.1	18.5	81.4	62.9	144.3
1[illegible]	6.4	8.0	16.3	20.0	88.0	68.0	156.0
1990	6.9	8.6	17.6	21.5	94.6	73.1	167.7
1991	7.3	9.1	18.6	22.7	100.1	77.2	177.3
1992	7.6	9.5	19.4	23.7	104.5	80.6	185.1
1993	7.9	9.9	20.1	24.7	108.9	84.0	192.9
1994	8.2	10.2	20.9	25.5	112.2	86.7	198.9
1995	8.5	10.6	21.7	26.5	116.6	90.1	206.7
1996	8.8	11.0	22.4	27.5	121.0	93.5	214.5
1997	9.1	11.4	23.2	28.5	125.4	96.9	222.3
1998	9.4	11.8	24.0	29.5	129.8	100.3	230.1
1999	9.7	12.2	24.7	30.5	134.2	103.7	237.9
2[illegible]	10.0	12.5	25.5	31.3	137.5	106.4	243.9
2001	10.3	12.9	26.3	32.3	141.9	109.8	251.7
2002	10.6	13.3	27.0	33.2	146.3	112.9	259.2
2003	10.9	13.6	27.8	34.0	149.6	115.6	265.2
2004	11.2	14.0	28.6	35.0	154.0	119.0	273.0
2005	11.5	14.4	29.3	36.0	158.4	122.4	280.8
2006	11.8	14.8	30.0	37.0	162.8	125.8	288.6
2007	12.1	15.1	30.8	37.7	166.1	128.2	294.3
2008	12.4	15.5	31.6	38.7	170.5	131.6	302.1
2009	12.7	15.9	32.4	39.7	174.9	135.0	309.9
2010	13.0	16.3	33.2	40.7	179.3	138.4	317.7
2011	13.3	16.6	33.9	41.5	182.6	141.1	323.7
2012	13.6	17.0	34.7	42.5	187.0	144.5	331.5
2013	13.9	17.4	35.4	43.5	191.4	147.9	339.3
2014	14.2	17.8	36.2	44.5	195.8	151.3	347.1
2015	14.5	18.1	37.0	45.3	199.1	154.0	353.1

REVENUES AND INVESTMENT COSTS

		ANNUAL REVENUES $Millions	OPERATING & MAINTENANCE COSTS	ADDED FUEL COSTS* Millions	NET REVENUES $Millions	INVESTMENT COSTS FIXED LINK $Millions	INVESTMENT COSTS FERRY ASSETS	PRESENT WORTH VALUES @ 10% REVENUES $Millions	PRESENT WORTH VALUES @ 10% COSTS $Millions	PRESENT WORTH VALUES @ 5% REVENUES $Millions	PRESENT WORTH VALUES @ 5% COSTS $Millions	IF FIXED LINK COST IS $4 BILLION	IF FIXED LINK COST IS $2 BILLION
1980													
1981													
1982													
1983	Yr. 1					1000			907		952	1269	634
1984	2					1000			823		906	1208	604
1885	3					1000			746		862	1150	575
1986	4	125	10	4	111		88	75	60	91	72	72	72
1987	5	134	10	5	119			73		93			
1988	6	144	15	5	124			69		92			
1989	7	156	15	6	135			68		96			
1990	8	168	20	6	142			65		96			
1991	9	177	20	6	151			63		101			
1992	10	185	20	7	158			60		96			
1993	11	193	20	7	166			57		96			
1994	12	199	20	7	172			53		95			
1995	13	207	20	7	180			51		95			
1996	14	214	50	8	156			40		78			
1997	15	222	20	8	194			45		92			
1998	16	230	20	8	202			42		92			
1999	17	238	20	9	209			40		90			
2000	18	246	20	9	217			37		89			
2001	19	252	20	9	223			35		87			
2002	20	259	20	9	230			33		86			
2003	21	265	20	10	235			30		83			
2004	22	273	20	10	243			28		82			
2005	23	281	50	10	221			23		71			
2006	Yr. 24	289	20	10	259			25		79			
2007	25	294	20	11	263			23		77			
2008	26	302	20	11	271			21		75			
2009	27	310	20	11	279			20		73			
2010	28	318	20	11	287			19		72			
2011	29	324	20	12	292			17		70			
2012	30	331	50	12	269			14		61			
2013	31	339	20	12	307			15		66			
2014	32	347	20	13	314			14		65			
2015	33	353	20	13	320			13		63			
								$1,168	$2,536	$2,502	$2,792	$3,699	$1,885

* based upon an added cost of $0.80/crossing/vehicle and number of vehicles is 88% of A.E.S.

Report on Shipping Traffic Movements

1. There is no precise count or record kept of vessel movements through the Strait of Georgia. The Port of Vancouver keeps records of deep-sea vessels, and coastwise vessels using the Port but these have only limited value in specific relation to the Strait of Georgia. Nevertheless, they are indicative of annual movements over a 10-year period. Table 1 below gives a 10-year summary of the number of deep-sea vessels and their tonnages.

Table 1

	Number of Deep-sea Vessels	Tonnage (000)	Net and Gross Registered Tonnages
1970	2,103	13,885	NRT
1971	2,135	16,810	NRT
1972	2,029	17,266	NRT
1973	2,222	31,640	GRT
1974	2,022	31,393	GRT
1975	1,907	30,721	GRT
1976	1,931	31,790	GRT
1977	2,185	36,416	GRT
1978	2,370	40,629	GRT
1979	2,291	41,009	GRT

It is reasonable to assume that the majority of these ships will have passed through the Strait of Georgia twice - once sailing in and once sailing out.

The figures provided by the Port of Vancouver of Coastwise vessels is of less value because it includes vessels travelling north and also movements of ferry ships at the Tsawwassen Terminal. These figures are therefore not considered.

It should be noted also that the Port of Vancouver figures do not include shipping movements up the Fraser River to New Westminster.

2. More accurate information of ships' movements in the Strait is provided by the Vessel Traffic Management Centre of the Canadian Coast Guard in West Vancouver. This administers the VTM System within the coastal waters of Vancouver Island including the Strait of Juan de Fuca, Strait of Georgia, Burrard Inlet, Howe Sound, Malaspina Strait, Johnstone Strait, Broughton Strait, Queen Charlotte Strait, Gordon Channel, Goletas Channel, part of Queen Charlotte Sound and parts of the Fraser River.

The statistics compiled are again not specifically related to Strait of Georgia movements but some indication can be obtained by examining the figures for Vancouver Harbour movements, shown below in Table 2.

Table 2

Vancouver Harbour Arrivals and Departures (Movements)

	1978	1979
Freighters	4,381	4,388
Tankers	469	420
Coastal	4,190	4,495
Tugs (with or without tows)	21,553	22,706
Ferries	2,153	2,089
Government	771	849
Miscellaneous	1,526	1,537

These figures include those movements from, for example, Vancouver to Nanaimo (e.g. ferries) and to northern ports. This will particularly be the case for tug movements.

3. Detailed records are available of individual ships' movements but it would be necessary to tabulate these manually. This would take some time - about a month. However a rough indication of the density of shipping movements in the Strait of Georgia is given in the following Table 3.

Table 3

Estimated Movements of Ships through the Strait of Georgia

	1980
Freighters	4,000 - 5,000
Tankers	400 - 500
Coastal	4,000 - 5,000
Tugs (with and without tows)	15,000 -20,000
Ferries	- -
Government	700 - 900
Miscellaneous	1,200 - 1,500
TOTAL	25,300 -32,900

In terms of the larger ships, the movement of ships will be in the range of 4,500 - 5,500 annually.

We have no records immediately available giving a frequency distribution by size of ship.

The monthly frequency distribution of the total number of movements would be about - 8 months - 1,900 - 2,500 movements/month
- 4 months - 2,500 - 3,200 movements/month
with the peak two months being in July/August and being slightly higher than the average of the four peak months.

The actual numbers of concern to the Study will vary according to the actual location of a fixed link crossing i.e. in relation to the number of ships using Roberts Bank and the Fraser River.

4. The maximum size of ships would be about 150,000 tons governed by the entrance channel of the First Narrows Bridge into Vancouver Harbour with its 50' draft. The largest tankers would be about 60,000 tons governed by navigation through the Second Narrows Bridges in Vancouver Harbour.

5. Some considerations affecting shipping in the Strait are:
   - the sea can often be choppy but usually not a 'heavy' sea.
   - a large number of ships running empty, not ballasted which can take on windage and be hard to steer.
   - a large number of tugs under tow. There is the possibility that tugs could be persuaded to install drop-masts.
   - the Vessel Traffic Management Centre in West Vancouver is very well equipped to control all movements in the Strait of Georgia which can provide adequate support for navigating through openings on the bridge - link.

CHAPTER SIX

AN ASSESSMENT

OF THE

FIXED-LINK CROSSING

CHAPTER 6

AN ASSESSMENT OF THE FIXED-LINK CROSSING

6.1 In the previous two chapters , appraisals were made of the economics of continuing to operate ferry services, and the construction of a Fixed-Link crossing. These indicated that the internal rate of return on new capital investments in the ferry system would be about 5% and that on a Fixed-Link costing $3 billion, the rate of return would be about 3.5%. The ferry service therefore appears at first sight a better economic proposition. However the comparison is close enough to warrant a review of some of the factors that enter into the respective evaluations to see what the results might be under slightly different conditions. These are assessed in the following paragraphs.

6.2 Insofar as the internal rate of return on new investments in the ferry system yielded 5%, this shall be the point of reference for evaluating the Fixed-Link crossing. Given a discount rate of 5%, the Net Present Worth of building a Fixed-Link under varying conditions would be as shown below:-

6.2.1 In the previous chapter, the Net Present Worth of a Fixed-Link crossing costing $3 billion was shown to be :

minus $300 million

6.2.2 If time savings are arbitrarily assigned a benefit value of 10% of the Net Revenues per annum, this would increase the present-day value of the stream of net revenues by $250 million (using a 5% discount factor) and accordingly the Net Present Worth would be:

minus $50 million

6.2.3 If the volume of traffic using a Fixed-Link is 30% higher than the ferry traffic instead of 25% higher as used in the study, this would raise the present day value of the stream of net revenues by approximately 5% or $125 million and the Net Present Worth would be:

minus $175 million

6.24 If the cost of constructing the Fixed-Link is $4 billion, the Net Present Worth would decline by $900 million and become:

minus $1,200 million

6.2.5 If the cost is only $2 billion the Net Present Worth would increase by $900 million and become:

plus $600 million

6.2.6 If the construction of the Fixed-Link is put back five years to be in service in 1991 and not 1986, and the cost of construction in 1980 prices remains unchanged at $3 billion, the Net Present Worth would increase by $500 million and become:

plus $200 million

(See Tables 6.1)

6.2.7 If the cost is $4 billion and the project is delayed five years, the Net Present Worth would decline by $400 million and become:

minus $700 million

6.2.8 If the life of the Fixed-Link crossing is longer than the thirty years used for the study period and if the costs of maintenance and repair continue to be in the same order of $20 million annually as in the first thirty years of the life of the Fixed-Link, then this would result in new Present Worth Values of about:

- assuming a 40 year life - plus $250 million
- assuming a 50 year life - plus $700 million

However a special caution must be noted:- If the life of the Fixed-Link is extended, then the traffic volumes may grow to the point where two additional lanes would have to be added to the crossing at some unspecified cost. In these circumstances the Net Present Worth figures shown above would not be valid.

6.2.9 If the annual operating and maintenance costs are $10 million a year less than forecast then the Net Present Worth would increase by $160 million and become:

minus $140 million

6.2.10 The above results are tabulated in the following Table of Present Worth Values using a 5% discount rate:

Table 6.1

		PRESENT WORTH VALUES OF COSTS in millions	BENEFITS in millions	NET PRESENT WORTH VALUE in millions
1.	Base Case	$2,800	$2,500	$ - 300
2.	Value of Time Savings (arbitrary)	2,800	2,750	- 50
3.	Increased Traffic	2,800	2,625	- 175
4.	Construction Cost is $4 billion	3,700	2,500	- 1200
5.	Construction Cost is $2 billion	1,900	2,500	+ 600
6.	Project Delayed 5 years-Cost $3 bn.	2,800	3,000	+ 200
7.	Project Delayed 5 years-Cost $4 bn.	3,700	3,000	- 700

NOTE: In each of the above cases, only one of the factors is changed at a time.

6.3 While one can vary the conditions under which the Fixed-Link is built and in service, it is also possible to vary the possible conditions under which ferry services are provided.

These include:-

6.3.1 The study of the ferry service was predicated on the "raised" ships having a capacity of 290 automobile equivalent spaces, i.e. 98 more than the present capacity of the "stretched" ships. The latest engineering information is that it may be possible to increase their capacity to 400 auto equiv. spaces. This would then give them a comparable capacity to the present "C" class ships of 360 A.E.S. size. Not only would this delay the acquisition of totally new "C" class ships as planned but it would also mean that the "raised" ships need not be phased out (retired) after giving just 12 years of service with the added deck. Their life would be much extended and this together with not having to buy more new ships or build new terminals so soon, would reduce the amount of new capital investment in the ferry system. It would also reduce operating costs on a per

vehicle basis. The effect of all these changes raises the internal rate of return applicable to ferry services.

6.3.2 Consideration might also be given to the possibility that it may yet prove to be impossible to "raise" the "stretched" ships to add a deck. If this was the case, then the investment cost of more new ships would be higher than forecast. This would reduce the internal rate of return applicable to ferry services.

6.4 The Fixed-Link construction costs are particularly sensitive to evaluation since they are incurred at the beginning of the project and therefore are very little discounted compared with the investment costs in ferry services that are incurred over an extended period of time. The reliability of any of the cost estimates for a Fixed-Link are suspect in that the crossing would by about a factor of 5 be the longest such "bridge" concept in the world; being unique, unforeseeable problems could cause the costs to be higher than estimated.

6.5 Provision in the cost estimates of a Fixed-Link for stand-by reserve sections should also be considered so that in the event of an accidental collision which damages the "bridge", replacement sections are quickly available. Damage inflicted to the Fixed-Link could cause more serious disruptions to the traffic flow between the Island and the Mainland than accidents involving a single ferry vessel or a terminal.

6.6 Some consideration could also be given to the justification for "shadow pricing" the cost of the labour that would be employed in the construction of the Fixed Link. This would require fairly considerable numbers of both skilled and unskilled labour; and in drawing them to this project in a concentrated period of time, it could cause shortages in other sectors of the economy thus driving up the price of labour everywhere. Special consideration too might be have to be given to the concentrated demand for wire cables for the project. Similarly, a case can be made out for shadow-pricing the cost of the capital required in the project. Finding $3 billion in a short period of time would obviously have an effect on the availability of money and its cost in the capital market for other projects. None of these considerations have been given an economic value in the study but they are factors that exert some influence.

6.7 The evaluation of the economic worth of a Fixed-Link crossing assumed a toll structure comparable to a ferry fare structure. It would not have been rational to have assumed a toll structure higher than the ferry fares because firstly, one would be substituting a more expensive service for a less expensive service, and secondly, a higher toll structure would presumably result in less traffic, and possibly smaller revenues. On the other hand a lower toll structure could be established at a level that would greatly stimulate traffic but which might lead to lower total revenues, and the consequent need for government subsidies. Consideration may want to be given therefore to subsidising traffic to and from Vancouver Island in order to achieve some specific economic or social objectives. Subsidies of course involve a redistribution of Provincial income from one group of taxpayers to another, and from one area or region to another area or region. In this context subsidies are interpreted to mean at a level higher than that associated with the Highway Equivalent Subsidy presently paid to the B.C. Ferry Corporation for Routes 1 and 2. (As stated earlier, this subsidy has not been taken into account in the evaluation of both the ferry system and the Fixed-Link crossing since presumably it would be paid to both systems in the same amount).

6.8 The point may be raised that one should evaluate the economics of a Fixed-Link crossing and the capital it requires against other government spending alternatives on such as housing, education, economic development etc. etc. This is not a valid point since one is simply measuring the cost and benefits of constructing a Fixed-Link crossing with that of a ferry system. So long as it is a policy objective to maintain transport links with Vancouver Island - as of course it obviously is - then the purpose of this study is simply to determine the most economic means of achieving that purpose.

6.9 This study has not involved itself with other means of transportation to Vancouver Island such as Hydrofoil ships or Hovercraft. Neither are full substitutes for a Ferry Service or a Fixed-Link crossing. Both could be used to augment a Ferry Service or Fixed-Link crossing but consideration of such alternative services is not relevant to the main issue of Ferry vs. Fixed-Link.

6.10 The question of traffic projections is raised once more to give added emphasis to its critical role in this comparative evaulation. The traffic forecasts for ferry services have it is believed erred on the high side being sustained by an annual compounded growth of 8% to 1990 thereafter rising by a constant figure each year. (Case 13). It was further assumed that if a Fixed-Link was built, the Fixed-Link traffic would be higher by 25% than the ferry traffic projections. The grounds for especially supporting these traffic estimates are the past growth figures, and the strong westward migration of people to the West Coast of the United States. This same westward trend is likely to be seen in British Columbia to an extent that may be more significant than shown in the population projections of "B.C. Research". If the traffic projections turn out to be less than forecast, then ferry services can be adjusted readily whereas a Fixed-Link, once built, is in place regardless of the traffic volumes.

There may therefore be some advantage to be gained by delaying a decision on building a Fixed-Link crossing until it can be seen that the traffic volumes are in fact in line with the traffic projections.

6.11 The fact that more capital investments in the ferry system will have to be made before a decision on a Fixed-Link is taken need not be a serious deterrent to delaying a decision. The expenditures on the ferry system while not small are still not of the same magnitude as those involved in building a Fixed-Link.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

Table 6.1

REVENUES AND INVESTMENT COSTS

DELAYED CONSTRUCTION

	YEAR	ANNUAL REVENUES $Millions	OPERATING & MAINTENANCE COSTS $Millions	ADDED FUEL COSTS $Millions	TOTAL NET REVENUE $Millions	INVESTMENT COSTS FIXED LINK $Millions	INVESTMENT COSTS FERRY ASSETS $Millions	INVESTMENT COSTS TOTAL $Millions	PRESENT WORTH VALUES @5% REVENUES $Millions	PRESENT WORTH VALUES @5% COSTS $Millions	IF FIXED LINK COST IS $4 BILLION
1987											
1988	1					1000		1000		952	1269
1989	2					1000		1000		906	1208
1990	3					1000		1000		862	1150
1991	4	177	10	6	161		88	88	132	72	72
1992	5	185	10	7	168				131		
1993	6	193	15	7	171				127		
1994	7	199	15	7	177				125		
1995	8	207	20	7	180				121		
1996	9	214	20	8	186				119		
1997	10	222	20	8	194				118		
1998	11	230	20	8	202				117		
1999	12	238	20	8	210				116		
2000	13	246	20	9	217				114		
2001	14	252	50	9	193				97		
2002	15	259	20	9	230				110		
2003	16	265	20	9	236				107		
2004	17	273	20	10	243				105		
2005	18	281	20	10	251				103		
2006	19	289	20	10	259				101		
2007	20	294	20	10	264				98		
2008	21	302	20	11	271				96		
2009	22	310	20	11	279				94		
2010	23	318	50	11	257				82		
2011	24	324	20	11	293				90		
2012	25	331	20	12	299				87		
2013	26	339	20	12	307				85		
2014	27	347	20	12	315				83		
2015	28	353	20	13	320				80		
2016	29	360	20	13	327				78		
2017	30	368	50	13	305				69		
2018	31	376	20	13	343				74		
2019	32	384	20	14	350				72		
2020	33	392	20	14	358				70		
									$3,001	$2,792	$3,699

CHAPTER 7

Conclusions and Recommendations

7.1 An analytical framework has been developed in the preceding chapters which permits a rational evaluation of the net benefits of constructing a Fixed-Link Crossing.

A large number of variable factors are involved in the evaluation and one must be assured that reasonable values have been given to these variables. It has been particularly important to indicate the directional influence of each factor and its relative importance. While every effort has been made to assess these correctly, there are some that have been difficult to assess, are significant and which require further detailed evaluation. In particular one has to be assured that the engineering concepts are practicable and that the estimated costs are within the range of those considered in this study. A full assessment of the environmental impacts will also be necessary.

7.2 There is no clear-cut evidence that would substantiate construction of a Fixed-Link at this time. But it is apparent also that a strong case can be made supporting its construction if its cost is little more than $3,000 million and if some of the benefits were reasonably judged to be higher than estimated.

7.3 One definite conclusion does however emerge: that the economics of constructing a Fixed-Link Crossing will become more favourable as time passes, and as the volume of traffic increases.

7.4 The corollary is that the subject should continue to be studied so that even if now is not the best time to proceed, one should be able to recognize when that time has arrived.

7.5 In this respect, it is therefore necessary to review this present study in depth, refine it where necessary and prepare a further report. It is therefore recommended that -

(i) copies of this pre-feasibility report be circulated among the different Ministries of the Government and other interested Public

and Private Bodies, and that:-

(ii) such parties be invited to comment on the many factors involved and assign more specific values to those factors if they have evidence that would support new values. Given this added input, the Report can be re-worked and amended as necessary. Final recommendations could then follow prior to a decision having to be taken as to whether a full feasibility study should be authorized.